

Technology Review

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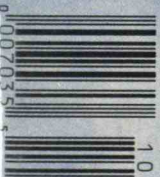
VIRTUAL REALITY

The Next Best Thing to Being There?



ALSO IN THIS ISSUE:

- ◆ HIGH-TECH HELP FOR THE NIGHT SHIFT ◆ BERNADINE HEALY ON REVAMPING NIH ◆
- ◆ SUBDUING SOFTWARE PIRATES ◆ KEEPING THE GRAND CANYON GRAND ◆
- ◆ A NEW ENERGY PATH FOR DEVELOPING NATIONS ◆






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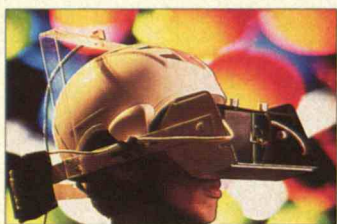
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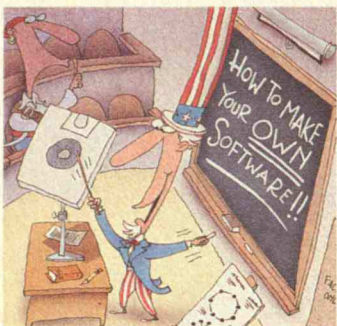


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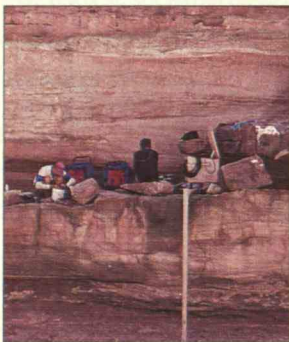
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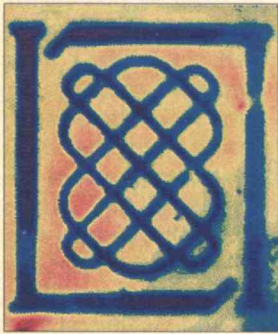
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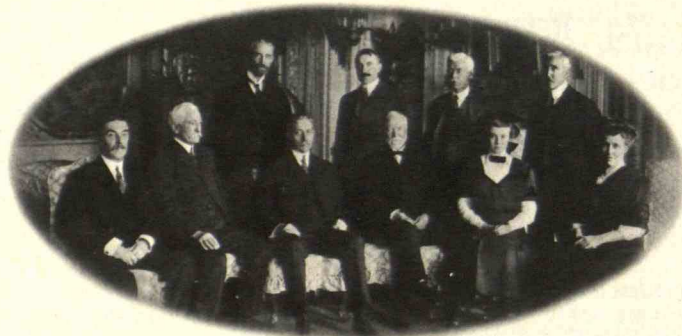
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First Line

Our Place in Time

IT's important in journalism to be timely—to explore for the public “what’s new.” But to a magazine like *Technology Review*, which dates its issues by the month rather than the week or the day, what’s new and what’s news are two different things.

Our beat embraces stories that are timely but usually nonperishable—the country’s manufacturing, environmental, and health-care problems, for example, will not disappear overnight. Yet because fast-breaking world events can make an article instantly obsolete, we sometimes have to do a pretty quick shuffle when circumstances so dictate.

Take the previous (August/September) issue. I found myself praying that the space station would survive its ordeal in Congress even though I personally think the country would be better off without it. I also wanted the deal makers in the phone, cable, computer, and entertainment industries to postpone their imaginative, economy-stimulating partnerships for just a few weeks more. And I wished that *TR*’s colleagues elsewhere in the media would temporarily fail to discover the “information highway,” despite its interest and importance to the public.

In the first case, the reason was that the centerpiece of David Callahan’s feature article, “A Fork in the Road to Space,” was a systematic and detailed argument for abandoning the space station. But during June, while we were editorially finishing the issue, a series of legislative debates made it appear that the space station could well be voted down. Wouldn’t we look silly coming out a month later with an author-analyst’s recommendations to kill something already killed?

I was tempted to write my congressperson. Meanwhile, we kept updating the article, even though it was nominally “in the can.” And to avoid the worst-case scenario, we prepared another article of the same length to substi-

tute at the eleventh hour if the space station was indeed terminated. As things turned out, it survived by one vote.

My other prayers were in support of Herb Brody’s incisive article, “Information Highway: The Home Front,” which addressed the new interactive medium soon to be available at your local TV set. No sooner had we “finished” the story than a rapid series of joint-venture announcements by the industries’ giants kept requiring changes in the score card—not unlike our vigil on the space station.

*Long after
the newspaper disappears
into the bird cage, the
monthly magazine
(usually) stays
fresh.*

Another annoying wrinkle was the avalanche of media attention. As our fully dressed star player, so to speak, was taking the short walk from the locker room, a flock of heavy hitters—*Newsweek*, *Time*, and *Business Week*, among others—were already on the field.

Some years ago, I left *Technology Review* and joined the *New York Times*. I was sad to leave my colleagues at MIT, but not so sad, at the time, to part with the interminable delays that go along with producing monthly magazines. “Articles just never got out of my hair,” I told an ex-newspaperman friend as my transition began. That won’t be the case at the *Times*, he assured me. “One of the great pleasures of daily journalism is filing your story in the evening and seeing it again the next day—in the paper.”

He was right. The quick turnaround of a newspaper was often ecstasy. Unfortunately, it was just as often agony: articles frequently “got out of my hair” too fast. By newspaper standards, we at the *Times* may have done a thorough job. But I was too often left with the impres-

sion that we had only scratched the surface of a story. There were so many leads left unexamined, so many implications ignored or never identified in the first place for lack of time.

But remember the essential word in newspaper and news weekly and the nightly news. Readers or viewers mainly want to learn the basics of today’s news on television this evening or in tomorrow morning’s paper. By contrast, it is up to magazines like *TR*, as a business editor once put it, to “add value” to the news—to take the time to follow up those unpursued leads, integrate them with information from other events present and past, and provide an analysis of the implications. The result will likely be relevant for a long while to come.

I left the newspaper world and came back to magazines with a renewed respect for all those “interminable delays.” It takes time, after all, to establish depth and durability—to “add value”—and magazine people usually have that time. Their occasional vulnerability to sudden events is simply an acceptable cost of doing business.

Thus Callahan’s article on the space station transcended the daily ups and downs—though it certainly couldn’t ignore them—to analyze the project’s history, the detailed arguments of its advocates and opponents, the political/economic context, and the technological alternatives. And Brody’s article on the information highway added value to the news by exploring the technological foundations of the new medium, the business forces arraying to build it, and the likely reactions both among service providers and consumers.

Ironically, magazines are usually better equipped than the nation’s daily media to present “what’s new”—as opposed to “what’s news”—in a fresh, interesting, and in-depth way. Still, we must ask your forgiveness if one of these days the ground shifts on a particular story while your copy is in the mail. ■

—STEVEN J. MARCUS

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Letters

THE FIGHT AGAINST BREAST CANCER

I do not share Susan Love's enthusiasm about being "on the verge of identifying the gene that causes hereditary breast cancer" (*"Confronting Breast Cancer," Interview, TR May/June 1993*). For one thing, such a statement misrepresents how genes function. If a certain gene "caused" breast cancer, we would expect

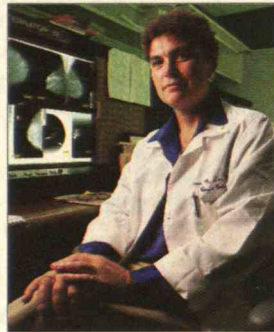
any woman who has it to develop the condition. In fact, while women who carry this gene are at increased risk, not all of them get breast cancer. No single cellular component or activity is responsible for the growth of a cancer. It always involves multiple factors.

Love also misleads the reader when she says that "genes seem to be at the root of all breast cancer." It is true that the most popular model of how cancers develop holds that mutations in genes are always involved. But these changes are usually not inherited; they are brought about by exposure to radiation or toxic substances, including hormones. Scientists think that when a number of genes in the nucleus of one cell undergo specific mutations, that cell may escape the usual controls on random proliferation, and cancer could result. The fact that such mutations must accumulate is believed to be the reason the incidence of cancer increases with age.

Love holds out the promise that "extremely early" detection of aberrant genes could lead to "gene therapy." Yet there is a great distance between identifying the genetic alterations implicated in breast cancer and knowing how to repair them. At present, it is difficult even to conceptualize the kinds of manipulations that would be needed.

Also, the gene variation(s) associated with so-called hereditary breast cancer may or may not be relevant to the development of breast cancer among women who have no known risk factors. Answering that question will require long-term epidemiological studies, and

in the meantime cancer researchers and physicians, proceeding on the unwarranted assumption that a particular gene variation always constitutes a predictive or early diagnosis of breast cancer, could single out women who have such a variation and intervene with "preventive" measures, all of which carry risks of their own.



The observed increase in the incidence of breast cancer has social causes, which Love and other cancer specialists often interpret in biological terms. Just one example: As increasing numbers of women have entered the paid work force, they have delayed childbearing. This more lengthy interval between the onset of men-

struation and a first completed pregnancy is thought to increase susceptibility to breast cancer. Clearly, a way to reduce the risk would be to make it easier for employed women to have children—by providing good, affordable childcare and extended, paid parental leave. Another worthwhile step in fighting breast cancer would be to reduce or eliminate exposures to radiation, environmental toxins, and stressors that affect large numbers of women.

RUTH HUBBARD
Professor of Biology Emerita
Harvard University

From a human standpoint, Susan Love's advocacy of increased sensitivity and compassion is right on the mark. But from a technical standpoint, her insights about breast cancer seem distressingly establishmentarian, emphasizing diagnosis and treatment while dancing politician-like around the issue of prevention. It is enormously disturbing that despite six decades of improvements—mammography, lumpectomy, radiation, chemotherapy—the mortality rate for breast cancer in 1990 is unchanged from that in 1930. Given this dismal record, Love's hope that her daughter will have no cases of breast

cancer to treat seems mere fantasy.

Love emphasizes the importance of genes in breast cancer, and here she touches the heart of the matter. Human genes have changed only 0.005 percent in the past 10,000 years; from the genetic standpoint, we're still Stone Agers. The problem is that our genetically determined Stone Age physiology now interacts with Space Age circumstances.

One important difference is that for Americans, the onset of menstruation is earlier and first birth later than for our Stone Age ancestors. Also, the total number of births is lower, the duration and intensity of nursing is less, and menopause is later. That is, each parameter has deviated from the pattern for which human physiology was adapted through eons of evolutionary selection. The reproductive experience of American women today appears to increase the average cell turnover rate in breast tissue, and carcinogenic mutations are more likely under such conditions. The epidemiologically best-established risk factors for breast cancer have to do with reproductive experience.

Social changes that restore the original pattern of human reproductive experience—including the six births per woman that was the norm during 99 percent of the time humans have existed—are highly unlikely. Accordingly, effective preventive efforts must likely be directed toward recreating the hormonal milieu for which human physiology has been designed.

Animal research has shown that hormonal therapy can delay the onset of menstruation and induce pseudo-pregnancy; birth control pills that can lower serum estrogen to levels found in hunter-gatherer women are being developed. Investigation along these lines needs to proceed. But more important, we need to begin a debate about the desirability of such measures. Interventions of this nature seem foreign and somehow repugnant, yet they really differ little from oral contraception.

The evolutionary paradigm suggests that a preventive approach including interventional endocrinology might

reduce the incidence of breast cancer from 1 in 8 to 1 in 800. The experience of the past 60 years provides little reason to believe that future advances in diagnosis or treatment, welcome as they will be, can have nearly as beneficial an effect on overall breast cancer mortality.

S. BOYD EATON

Adjunct Associate Professor of Anthropology
Clinical Associate Professor of Radiology
Emory University

Susan Love manages to respond to so many of the concerns that women have as they try to work through their fright at the word cancer. For all those women who have struggled to maintain a sense of calm and dignity, her words regarding the importance of support groups should have been printed in bold letters. Such groups, which offer true sisterhood, help women to leave animosity, greed, status, and prejudice behind.

My twin sister and I have both had double mastectomies for breast cancer that seems to be related to a family history. I hope that research in genetics will provide answers before my children and grandchildren become additional statistics.

BONNIE J. ALLISON
Denver, Colo.

HONESTY IN TV JOURNALISM

In "Hype and False Hope" (*TR Letters*, May/June 1993), Fred Jerome indulges himself in a heavy dose of misinformation. Reviewing the case of a paraplegic named Nan Davis, he suggests that *60 Minutes* provided less-than-honest coverage of her walk to receive a graduation diploma. He writes that "what the audience could not see was the men at her sides who were supporting her."

But if Ms. Davis has a problem with her legs, Mr. Jerome has one with his eyes. He might have been the only one in the *60 Minutes* audience of 30 million viewers who could not see the men supporting Ms. Davis.

DON HEWITT
Executive Producer
60 Minutes

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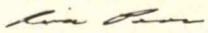
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Fred Jerome responds:

When Mr. Hewitt called me to complain about my letter in *TR*, he said he had the videotape and transcript of the *60 Minutes* report right in front of him. At my request, he read a key passage: "Nan Davis walked to receive her diploma, directed by computer with Dr. Petrofsky and Dr. Chandler Phillips there only as insurance."

"What do you think 'only as insurance' means?" I asked him. There was an uncharacteristic silence at the other end of the line.

I will accept one correction. Instead of "what the audience could not see were the men at her sides who were supporting her," the wording in my letter should have been "the audience could not see that the men at her sides were supporting her—and *60 Minutes* reported otherwise." I would like to believe Mr. Hewitt will be as meticulous in correcting the false record *60 Minutes* helped establish. And of course, there's a second issue here—that of whether *60 Minutes* knew they were participating in hype—but we'll leave that for another time.

SAFER OIL TRANSPORT

"Keeping the Oceans Oil-Free" by Judith Tegger Kildow (*TR* April 1993) should have more strongly emphasized accident prevention. Because the United States imports over 50 percent of its oil supply by sea, ports along the entire coastal margin are exposed to risks of a catastrophic spill. While such accidents are fortunately rare, damage can be enormous because tankers are so huge. Also, experience shows that less than 15 percent of spills can be contained and recaptured. Although many safeguards have been proposed over the last 20 years, most continue to be ignored. The entire system lacks a vigorous commitment to safety.

Still, Kildow's article does raise some key safety issues that federal authorities have neglected. In fact, this neglect has been so pronounced that the states of Alaska, California, and Washington have addressed the issues themselves, enacting their own risk-reduction measures for oil transport.

In its first annual report on marine safety, released last March, the Marine Oversight Board of Washington State found little to cheer. The board had asked the parties responsible for transport safety to identify which criteria they used to assess system functioning; none were forthcoming, so the board adopted its own. The board also discovered that a credible database was lacking. And although human error had been a factor in over 70 percent of accidents, corrective action had been directed at long-term research rather than at prompt adoption of proposals to strengthen mariner qualifications, licensing, testing, and retesting. Classification societies and insurance underwriters still overlook incentives to foster self-policing in the shipping industry. Only 7 of 56 risk-reduction measures in the 1990 federal legislation responding to the *Exxon Valdez* spill have been implemented.



I agree with Kildow that regulation of oil transport is fragmented. Creating a new federal agency, however, may not be necessary, much less feasible. The Coast Guard should integrate existing functions that deal piecemeal with spill prevention. It should also follow its mandated initiative to respond to spills vigorously through on-scene leadership and clear lines of authority. At the same time, individual coastal states should execute their own tough initiatives. To head off any confusion this might cause, the states should generate a compact among themselves that would transform collective actions into unified federal law.

EDWARD WENK, JR.
Seattle, Wash.

The writer, who served on the commission investigating the Exxon Valdez oil spill, is a member of the Marine Oversight Board of Washington State.

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MIT Reporter

CHIPPING AWAY AT PRINTING SMALLER CHIPS

 Silicon chips have grown more powerful each year for three decades, largely because of manufacturers' ability to shrink their circuitry. But the advanced optical process used to print features as small as 0.0005 millimeter across is running up against its inherent limitations, and manufacturers fear their billion-dollar production lines will be made obsolete by an even more expensive technology, x-ray lithography. Researchers at MIT's Lincoln Laboratory and several large Japanese companies are therefore trying to extend the usefulness of the existing process an extra five years or more.

The principal tool used in making chips is a wafer stepper, which prints circuit elements onto a silicon wafer by a process comparable to making a photographic print from a negative. Modern chips carry features so small that visible light cannot be used to print them; its wavelength is about as long as the features and so cannot produce a sharply focused image. Chipmakers have therefore abandoned visible light for ever shorter ultraviolet (UV) wavelengths. The wavelength now usually employed is 365 nanometers (billionths of a meter), and most members of the industry expect a wavelength of 248 nanometers to emerge in the next year or two.

The Lincoln Lab group, sponsored by the federal Advanced Research Projects Agency and headed by program manager Mordechai Rothschild, has been working to develop a process that will take advantage of 193-nanometer light, the last sliver of the ultraviolet region that can be easily manipulated.

One of the first challenges was finding a suitable material for the wafer stepper's lens, which focuses the circuit image on the silicon wafer. Although most glass does not transmit 193-nanometer-wavelength light, a form of fused silica glass will work. But this material exhibits what Rothschild calls

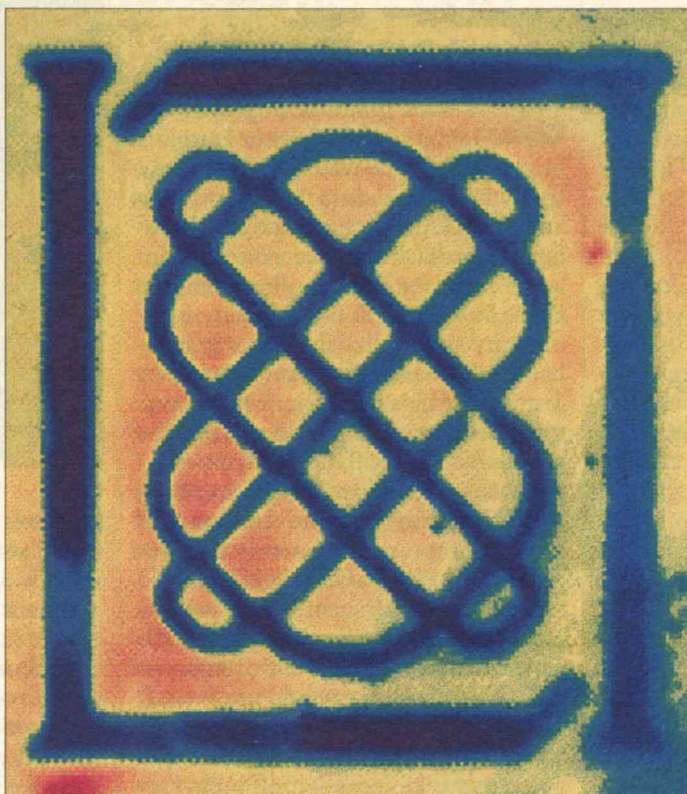
pulses, any variation would spoil a wafer-stepper lens, with its 30 optical elements and precision rivaled only by the lenses in spy satellites.

The shrinkage occurs when two photons are absorbed simultaneously in the same region of fused silica. Rothschild explains that this causes an atomic rearrangement, although details of the process aren't yet available despite various studies and hypotheses.

After a number of tries, the Lincoln Lab group's suppliers of fused silica have succeeded at making subtle adjustments to their proprietary growth processes and formulas to prepare a compound that appears to have good resistance to the two-photon damage. Through testing, the Lincoln Lab team has found that the compound's shrinkage increases as the square of the intensity of the laser used to generate the ultraviolet light—for example, a 3-fold increase in intensity causes a 9-fold jump in damage. But since steppers use lasers that are sufficiently low in intensity, the team members estimate that a lens built of the compound will stay within spec-

ifications under production conditions for at least 10 years—adequate for an industry that replaces leading-edge machines every three to five years. The same form of fused silica can also be used to make photomasks (the “negatives” that carry the circuit patterns), which have lower longevity requirements.

The team's other primary task is to find a suitable photoresist—a light-sensitive chemical that, like the emulsion on photographic film, records an image projected onto it. The photoresist must fulfill a multitude of conflicting roles. It must be supple enough to form a uniform coating just 0.001 millimeter thick when spun onto a silicon wafer, yet



Fused silica glass would be useful as a lens in printing smaller integrated circuits, but the material can shrink after long exposure to the light needed in the process. Here areas of the glass that have shrunk stand out when observed through a special optical instrument.

“all kinds of weird phenomena.” For example, it does not transmit light perfectly; as the thickness of the fused silica increases, more and more photons are trapped. The material also shrinks after extended exposure to the laser that generates the ultraviolet light. Although the resulting increase in density is only a few parts per million after millions of laser

remain tough enough after baking to serve as a protective mask against chemicals that etch metal. It must be sensitive enough to resolve an image of the tiniest features on the circuit, but robust enough for use in a factory. The resist should also be nontoxic, without unpleasant odors, manufacturable in bulk, and inexpensive.

Lab staff members Roderick Kunz, Mark Horn, and Mark Hartney first looked at a process in which an image is formed on the surface of the photoresist and then transferred into its body through exposure to a charged gas, or plasma. The technique is unattractive to chip companies, however, since the use of plasma would mean an additional complex production step. The companies also want to avoid problems they have encountered with resists for 248-nanometer-wavelength light. Trial production lines have been thrown into turmoil by such things as a change from one floor-cleaning compound to another or the tarring of a nearby parking lot; minute concentrations of airborne contaminants cause unwanted reactions in the resist.

An Idea from IBM Partners

Development partners at IBM have suggested that the Lincoln Lab team consider a methacrylate terpolymer compound. When photons hit this compound, they generate an acid, which in turn acts as a catalyst for a further reaction that produces the final image. Although capable of excellent resolution, the methacrylate terpolymer is not hard enough to stand up to the physical stress generated by the etching process, which involves bombardment by ions. To sidestep the problem, Horn is evaluating techniques such as lowering the energy of the etch ions.

Chipmakers will probably need a printing process using 193-nanometer-wavelength light near the end of the decade, says Burn Lin, former director of lithography at Sematech, the industry-government chip-manufacturing consortium. Within two years, the Lincoln Lab

group hopes to have a process that Sematech or individual companies could assess in their own research facilities. "We don't claim to solve their problems from A to Z, but we can be the yeast," says Rothschild. "We can generate enough swelling that someone can add more ingredients and make bread."

—PETER DUNN

BRIGHT LIGHT, BIG BUILDING

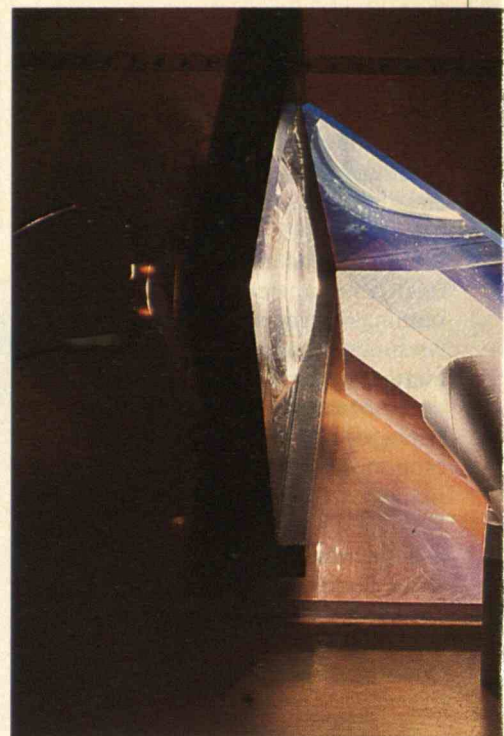


An evening stroll around midtown Manhattan gave Kurt Levens a bright idea. While watching a powerful spotlight sweep across the skyline, now and then lighting the outside of a building, he realized that the same kind of lamp could be used to illuminate the inside as well. Light from a single, high-intensity source, like the lamps in baseball parks—or even the sun—could be distributed by a network of fiber-optic cables. Such a system could also trap the heat that comes with light and use it.

Levens, a graduate student in MIT's Building Technology and Architectural Design programs, estimates that his approach to commercial lighting could be far more efficient than today's energy-saving fluorescent systems. To generate the same amount of light, he says, his technology would use 9 watts of electricity compared with 22 watts for an energy-saving fluorescent bulb and 50 watts for an incandescent bulb. Factor in the heat, and the system picks up even greater efficiency.

Fluorescent bulbs convert more than half the electricity they consume into heat, which must often be removed by electricity-driven cooling systems. While Levens' system produces a similar amount of heat, it is used to replace electricity, oil, or natural gas-driven heaters and air conditioners.

In a dusty, windowless architecture studio at MIT, Levens demonstrates an early model of his system, which he calls Lightline. One component is the "warm mirror," a square of glass coated on one side with a thin film of a metallic compound much like that used in heat-reflecting windows. This film lets visible



light pass through the glass while reflecting 98 percent of the infrared and ultraviolet wavelengths.

Levens plugs in a high-intensity discharge lamp and a blinding beam of light shoots straight up at the mirror, which is cocked at a 45-degree angle. Cool white light emerges from the mirror and plays on the ceiling over the bulb. Red light streams away from the mirror at a right angle. A piece of notebook paper slipped in front of this beam instantly chars, then erupts in flame.

How a System Will Function

In a working system, the white beam will be captured in a collector shaped like half a ball with tiny reflective funnels poking out. Any light that enters the area of the collector will be directed down the funnels, each of which ends at a light-carrying optical fiber the thickness of pencil lead.

At the same time, the heat will shine onto gutter-like troughs containing tubes of circulating water or other liquid suspended along their centers. The

In a simulation of Kurt Levens's illumination system, a treated mirror separates the light emanating from a powerful source (left). The cool visible light funneled into a fiber (bottom) would be directed to light fixtures throughout a building, while the hot infrared light could be used for heating (here it burns off piece of paper).

liquid will then be used for heating rooms and water or in "absorption-chiller" air conditioners. These devices employ heat rather than electricity to drive the evaporation and condensation cycles involved in air conditioning.

Levens plans to bundle dozens of flexible fibers into thick cables that will snake through a building's walls and ceilings, just like electrical wiring. For overhead lighting, an electrician would pull out a fiber and point it at a reflective panel to diffuse the light. Electrical switches wouldn't be needed. Russell Leslie, professor of architecture and associate director of the Lighting Research Center at Rensselaer Polytechnic Institute, says this setup could offer building owners or tenants greater flexibility. "You could move lighting around almost like an appliance," he explains.

Central lighting would also be ideally suited to take advantage of free sunlight, says Levens. Roof-mounted solar collectors called heliostats could shine sunlight into the illumination control room. There the light would be fed through the

mirror and into the fiber-optic distribution network along with or in place of artificial light. The huge amount of heat that comes with sunlight would be an extra benefit.

Elements of Levens's scheme have been kicking around for some time. Several researchers have explored the concept of separating light and heat at the source. In a few buildings in Japan, optical fibers carry sunlight from roof-top or ground-level solar collectors to windowless offices and basements. And General Motors is testing a fiber-optic device that would illuminate an automobile's headlights, taillights, and dashboard lights from a single bulb in the trunk.

But the economics of central lighting systems are "very difficult," cautions Stephen Selkowitz, who heads the Lawrence Berkeley Laboratory's research on windows and daylighting. Since individual fibers can't be dimmed or brightened, he says, workers don't have much control over the light they receive. And lighting an entire building for just one late-night employee might not be efficient.

"That's the Achilles' heel of this system," admits Levens. One solution for offices would be a light source on each floor rather than one central source. He also proposes that central lighting would work best for retail stores, warehouses, and factories, since these need constant amounts of light for long periods.

Levens estimates that in a new 5,000-square-foot retail store, his technology would cost up to \$30,000 to install, compared with up to \$20,000 for energy-saving fluorescent lights. But with Lightline, the building could get by with a smaller air-conditioning unit, and would consume much less electricity and have lower maintenance costs (far fewer bulbs to clean and replace). The inventor claims that the system could pay for itself in less than five years. Employing sunlight during the daytime could shorten the payback period to under one year, he says.

Levens is negotiating with a Canadian company about manufacturing his system.—P.J. SKERRETT

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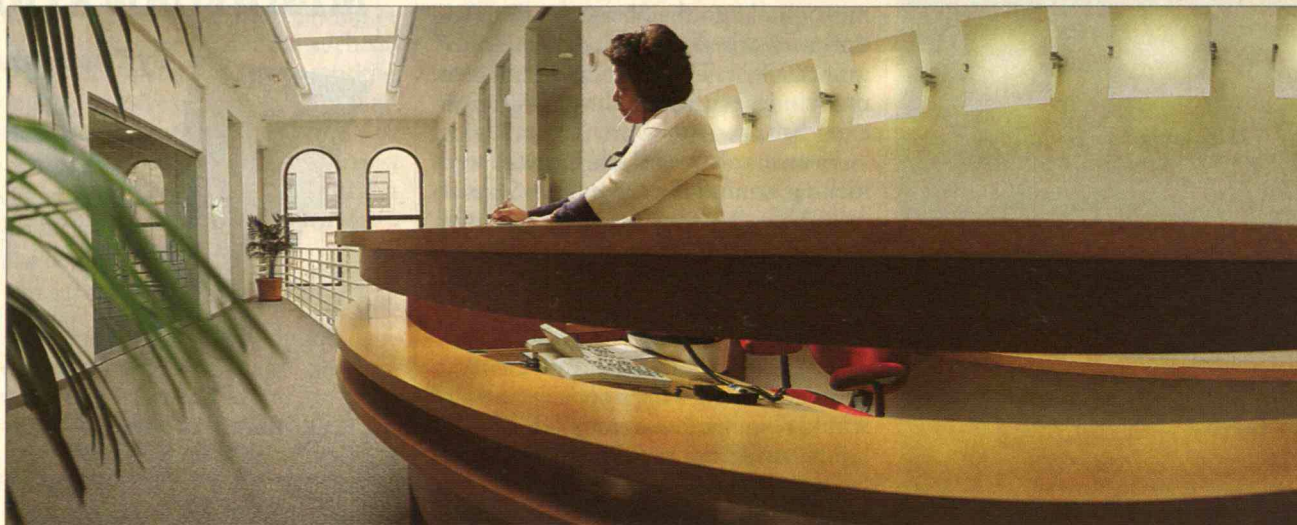
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Trends



The Greening of Architecture

Examined in the light of their effects on the environment, most modern building materials have serious drawbacks. Steel beams and plastic panels require far more energy to fabricate than brick or cement. Conventional plywoods, chipboards, and paneling use glues that produce formaldehyde gas. Synthetic carpets are made from dwindling petroleum-based materials and colored with toxic dyes. And paints, finishes, and solvents contain suspected carcinogens or volatile organic compounds (VOCs) that give chemically sensitive people headaches, dizziness, and respiratory problems.

But a growing number of architects maintain that by taking a little extra care in selecting building materials, it's possible to construct "ecologically correct" buildings. Take Randall Croxton, who designed the recently completed New York City headquarters for the National Audubon Society. By analyzing the entire lifecycle of each material—where the raw material came from, how it was processed, whether it was recyclable, and what health effect it would have on the building's occupants—his team was able to take a century-old department store and turn it into a showcase for environ-

From its sustainably harvested mahogany reception desk to its undyed wool carpets, the National Audubon Society headquarters is a showcase for ecological building materials.

mentally benign building materials.

Instead of formaldehyde-laden plywood, Croxton and company specified subfloors made of Homasote, a product made from recycled newspapers. Instead of using dyed synthetic carpet material, the design team chose to use wool woven in a tweed pattern from the fleece of three different varieties of sheep. And rather than laying conventional petroleum-based carpet padding, the team selected a substitute made from jute and animal hair. Other novelties included tiles made from recycled lightbulbs, non-chlorofluorocarbon (CFC) insulation made from a frothy low-density concrete, non-toxic and VOC-free paint, and a sleek, three-tiered reception desk made from sustainably harvested mahogany and non-endangered native maple.

But selecting building materials that safeguard health, protect the ozone layer, and preserve the rainforest can carry some penalties both in performance and price. For example, the concrete insulation Croxton decided on cost nearly twice as much as conventional CFC insulation and was only about 80 percent as effective.

Connecticut architect Paul Bierman-Lytle stresses that the problem is compounded because there are no clear-cut distinctions between green and non-green products. "There's a lot of hype about recycled products but unfortunately many are energy-intensive or toxic," he says. For example, "recycled carpet made from old plastic soda bottles still gives off the same toxic gases that regular nylon carpet does."

Jan Beyea, chief scientist at the Audubon Society, points out other such conflicts: a sustainably harvested product that is processed wastefully, a benign product that can't be reused, or a recycled product that keeps toxins in circulation. When push comes to shove, he says, "our top priority is to eliminate formaldehyde and volatile organic compounds."

Even when a good alternative exists, that is no guarantee it can be used. In the four years since Croxton completed his first major green project—the New York headquarters of the Natural Resources Defense Council—he has found "hundreds, if not thousands, of options that were superior ecologically but were unavailable at the time or too expensive."

The good news is that the number of resources available to help architects find suitable green materials is growing. For example, the Rainforest Alliance's

"Smart Wood" certification program and the Rainforest Action Network's Wood Users Guide list sources of "sustainably harvested mahogany" or "plantation-grown teak" along with lesser-known tropical hardwoods to ease the demand for perennial favorites. Another new service, the Forest Resource Information System, offers a computer database on the characteristics and potential uses of thousands of virtually unknown tropical wood species.

Architect Bierman-Lytle has established an eco-mall for environmental construction materials. First begun in 1981 as a mail-order business, Environmental Construction Outfitters is now a 5,000 square-foot loft in New York City that serves as a green depot for architects, designers, and contractors. Customers can choose from Bierman-Lytle's catalog that now includes 10 notebooks listing more than 2,600 environmentally sound building materials and technologies.

The American Institute of Architects (AIA), in partnership with the Environmental Protection Agency, has produced the Environmental Resource Guide, a quarterly subscription service that covers developments in the new field of green architecture. The guide reports case studies, life-cycle summaries for a range of materials, and special reports such as "The CFC Bind Revisited: What Architects Can Do."

A broader green-architecture movement—encompassing everything from site selection to waste-management systems for buildings—is also gaining official support. Among the most fervent converts is Susan Maxman, president of the AIA, who has dedicated her term to environmental concerns. This past June in Chicago the AIA held a joint meeting with the World Congress of Architects devoted to sustainable architecture. Citing a burgeoning number of both developers and suppliers with a professional interest and commitment to green architecture, Maxman proclaimed that "the timing is just right to make a huge impact on how we design buildings."

—DAVID BJERKLIE

Wanted: An Astute Nuclear Detective

A fiery debate is raging over the effectiveness of the UN-affiliated International Atomic Energy Agency (IAEA), the enforcement arm of the 1970 Treaty on the Non-Proliferation of Nuclear Weapons (NPT).

Created in 1957 during the Eisenhower administration's Atoms for Peace program, the Vienna-based IAEA has a dual mission: to promote peaceful uses of nuclear technology and materials, and to ensure that they are not diverted for military purposes. Under the terms of the treaty, signatory countries—which include almost all nations, including the five declared nuclear powers—agree not to manufacture or receive nuclear weapons and to allow the IAEA to inspect all their nuclear facilities.

Conflict of Interest

Criticized for years as ineffective at halting nuclear proliferation, the IAEA has been under close scrutiny since the Gulf War, when the United States discovered that Iraq, ostensibly a party to the NPT and IAEA's twice-yearly inspections, had covertly developed a multibillion-dollar nuclear weapons program employing about 20,000 people. Part of that program, the research reactor near Baghdad that was bombed by Israel in

1981, had been declared "peaceful" by IAEA inspectors, even though it was producing enough plutonium for two nuclear weapons a year.

Iraq had even been a frequent member of the IAEA's governing board. But UN inspectors sent to Iraq after the Gulf War uncovered evidence that after the Israeli attack, President Saddam Hussein appeared to have decided to main-

tain a pretense of adhering to the NPT and cooperating with the IAEA to obtain nuclear technology and materials more easily.

Critics contend that the agency's problems arise from an intractable conflict of interest. "The IAEA is programmed not to find bad things," says Gary Milhollin, director of the Wisconsin Project on Nuclear Arms Control, a non-profit research

organization. "If it does, that means its promotion function is a mistake."

Milhollin says this "inherent structural problem" explains why IAEA inspectors who visited the nuclear research complex at Tuwaitha, Iraq, every six months never looked beyond three "material balance areas" containing declared nuclear materials, and never tried to visit the more than 700 other buildings on the same site.

Echoing that view is David Kay, a former IAEA official sent to Iraq after the Gulf War as part of a UN Security Council inspection team. Not wanting to appear suspicious of countries using nuclear materials peacefully, he says,



IAEA inspectors tend to be too conservative and insufficiently aggressive.

Besides the IAEA's own timidity, the agency is hampered by lack of money and resources. In 1993, after an eight-year freeze, the IAEA's budget was finally increased, but only by 1.5 percent. To make matters worse, the money is being spent in the wrong countries, says Kay. More than half of the current IAEA inspection budget goes to Germany, Japan, and Canada, all of which have numerous reactors and declared materials, he says, but probably no aspirations to proliferate.

Getting Tough

Despite these problems, some believe the IAEA is fulfilling its obligations. "The IAEA has never been asked to root out nuclear ambitions," says Jon Wolfsthal, policy analyst with the Arms Control Association. "It is an alarm system, not a prevention system."

Leonard Spector, a proliferation expert at the Carnegie Endowment for International Peace, goes a step further, contending that the aggressive stance that IAEA recently took toward North Korea reveals the agency "at its best." When shown U.S. satellite surveillance photos and other evidence that North Korea was producing weapons material, the IAEA—for the first time ever—insisted on inspecting facilities that a country maintained were non-nuclear.

Spector and others point out the IAEA possesses such authority: After the NPT was signed in 1968, the UN issued an amendment giving the agency the right to inspect all nuclear materials in a country and conduct special inspections of undeclared facilities. And though North Korea has not yet complied with the IAEA's demand, the agency has at least succeeded in marshaling the support of other nations, such as the United States, who have threatened retaliation if the country continues to develop nuclear weapons.

But Paul Leventhal, president of the Nuclear Control Institute, which moni-

tors proliferation, says that North Korea and Iraq prove that the agency "can't cope with a country determined to cheat." He proposes turning over the agency's regulatory function to the UN Security Council, which has directed inspections in Iraq since the Gulf War. The Security Council could delegate routine inspections back to the IAEA. But giving oversight to the Security Council could circumvent the possibility that some members of the IAEA's board of governors—which is currently headed by Algeria and includes Libya and Syria, all considered potential nuclear powers—may have no interest in more efficient inspections.

Leventhal's plan poses legal and political difficulties, however. All members of the IAEA's board of governors must approve the change, and they are unlikely to relish yielding authority to the five major nuclear powers that compose the Security Council. In fact, Eldon V.C. Greenberg, counsel to the Nuclear Control Institute, believes this requirement makes the treaty almost impossible to amend. Moreover, the example of North Korea demonstrates the Security Council's limitations: North Korea's ally, China, though an NPT signatory nuclear power, has threatened to veto any ultimatum concerning inspections.

Both supporters and critics of the IAEA agree that the agency must only be one part of an international system to stem proliferation, and that such a system needs to demand stricter monitoring of, and limits on, the production of nuclear materials as well as the import and export of nuclear materials and technology. Yet however the IAEA is transformed into more of a "get-tough" agency, most analysts say, what it will need to function effectively is the complete support of all the major nuclear powers. As one member of the UN team in Iraq puts it, inspectors working in that country could be tough and thorough because "Iraq didn't have China looking after its interests."

—ANN MARIE CUNNINGHAM

High-Flying Swords into Plowshares

For more than two decades the SR-71 Blackbirds, a fleet of U.S. supersonic spy planes capable of skirting the upper reaches of the stratosphere, overflew enemy territory with impunity. But since the Cold War ended, the high-flying jets have been grounded with little purpose other than to sit in mothballs and await missions worthy of their powers.

Now two of the legendary Blackbirds have been brought back from retirement and re-enlisted, this time to be placed in the service of science. NASA is planning to use the lightning-fast planes at its Dry-



den Flight Research Facility in California's Mojave Desert to conduct niche research projects that scientists say are too costly to accomplish with satellites or the space shuttle, and impossible to perform with conventional rockets or balloons.

Powered by two turbojet engines, the imposing black planes—which resemble pointy-nosed manta rays—can reach an altitude of 85,000 feet and speeds of 2,200 miles per hour. Though each 90-

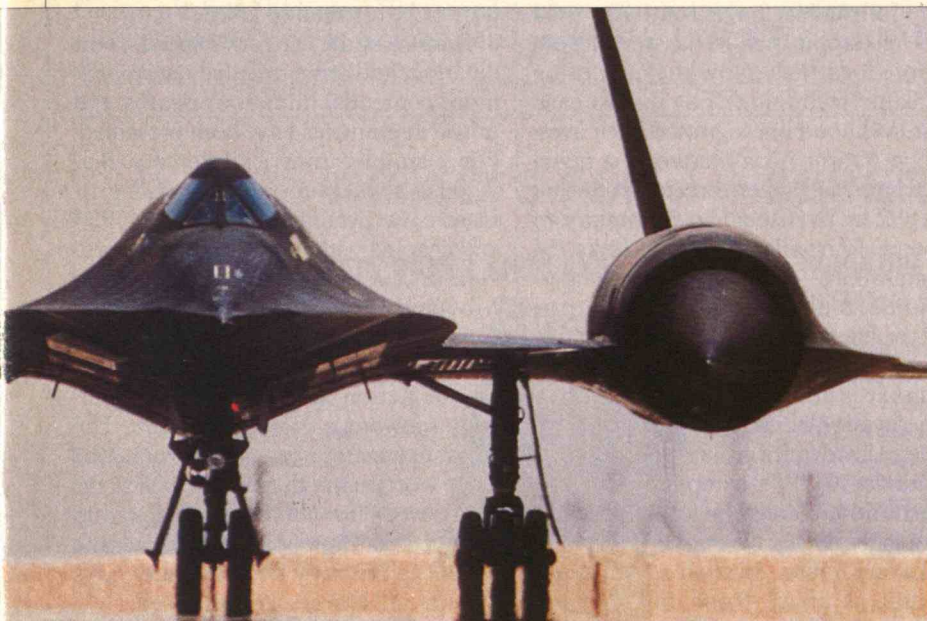
minute flight costs about \$100,000 in fuel and life support for the two-person crew, that's still about 100 times less expensive than lofting an experiment on a shuttle or satellite, estimates Jacklyn Green, a space scientist at NASA's Jet Propulsion Lab and director of the Blackbird research program. The budget for the program is \$3 million, enough for about 25 flights a year, she estimates.

NASA contends that the planes can be used for special assignments, such as those that must be accomplished under time constraints that the space shuttle or a rocket cannot meet. These include reconnaissance flights to study asteroids, comets, and supernova that suddenly burst into view. The planes could also fly

violet images through a 9-by-12-inch window on the top of the plane.

Scientists at the Jet Propulsion Lab have developed an ultraviolet spectrometer to enable the plane to survey the stratospheric ozone layer. Because the Blackbirds can go nearly 4 miles higher than the commonly used ER-2 research plane, which is limited to an altitude of about 12 miles, they can look down through a much thicker slice of ozone to provide a more complete picture, says Green.

But Sherwood Rowland, atmospheric scientist at the University of California at Irvine and an authority on stratospheric ozone, contends that since most ozone surveys can be carried out with existing



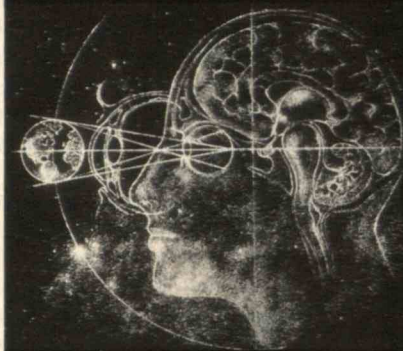
fast enough to stay within the shadow of a solar eclipse, which lasts only minutes on the ground, to study the sun's corona.

The first researcher to employ the planes, Alan Stern, an astronomer from the Southwest Research Institute in San Antonio, has used them to view asteroids in ultraviolet light (to help determine their size and composition) and will use them to search Venus for volcanic activity. A telescope mounted in the Blackbird's long nose captures ultra-

Retired since the end of the Cold War, the high-flying supersonic Blackbird spy planes have been re-enlisted by NASA to conduct scientific research in remote locations.

ground or satellite instruments, the plane is unnecessary. He points to the Perseus, a drone aircraft developed by another group at NASA specifically for atmospheric sampling. Though Perseus is still under development, he says it is

Society of Minds



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expected to attain the heights of the Blackbirds at a much slower speed, allowing it to sample the atmosphere more effectively. Rowland also points out that Perseus is far less expensive to operate than a Blackbird, can stay aloft for hours, and, because the Perseus is remote controlled, does not endanger a pilot's life during missions over remote areas.

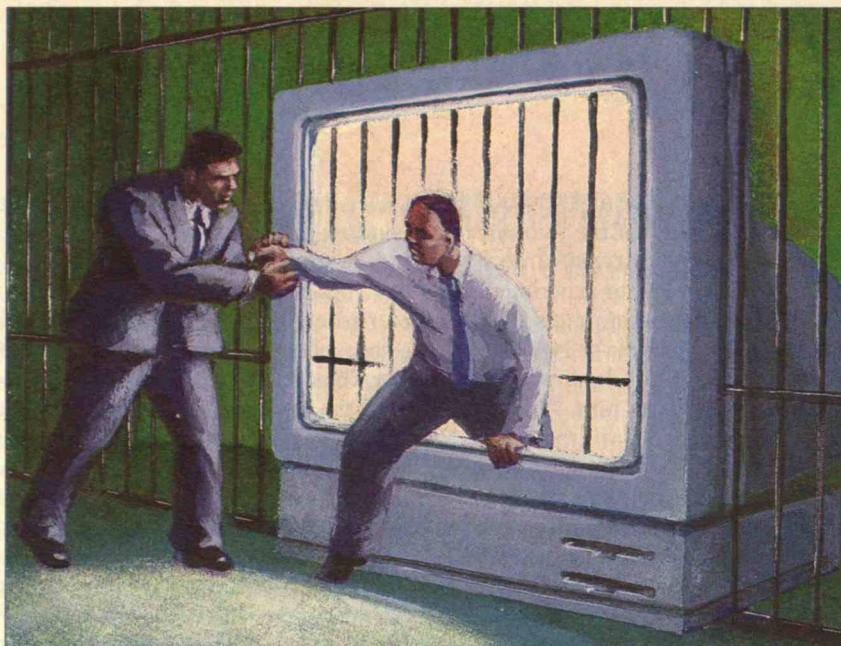
Custom Modifications

Rowland also argues that the Blackbirds are inappropriate for atmospheric studies because of the very speed that made them so effective for spying. At supersonic velocities, the plane scatters the atmosphere and may even change the chemistry of the molecules. Because the molecules are no longer pristine, he says, they become less valuable for study.

Researchers are trying to adapt the planes to ensure accurate atmospheric sampling. For example, a nozzle is being developed to reach in front of the plane and retrieve air samples before they are disturbed, Green says. For her own research on comets, Green is developing a material with a gel surface that could be attached to the exterior of the plane to catch comet dust that wafts through the stratosphere from outer space.

Arthur Lane, the atmospheric scientist who developed the Blackbird's ultraviolet spectrometer, contends that the former spy planes are valuable because they are available now and can conduct atmospheric research in places no other vehicles have gone before. For example, they could fly above unstable air surrounding a volcano to measure sulfur content and can fly fast enough to chase the contrails of rockets and analyze the effect of jet exhaust on the atmosphere.

The plane's flights are open to business payloads, too. Before the science flights began, NASA tested satellite communication equipment for Orbital Sciences Corp., based in Dulles, Virginia. Flying above about 95 percent of the atmosphere, Green says, the plane can simulate many of the conditions of outer space.—DAVID GRAHAM



Electronic Mail Springs Journalists

Journalists have routinely used electronic mail to file stories from remote locations. Now they are using the same technology not just to earn their livelihood but to protect their lives.

The Action Alert Network, a novel electronic mail system created in the fall of 1992 by the Canadian Committee to Protect Journalists (CCPJ), links 24 organizations—including Amnesty International, the International Red Cross, and the International Federation of Journalists—from 14 countries. The goal is to monitor human-rights and freedom-of-expression abuse of journalists, writers, and academics around the world.

Run by CCPJ's computer arm, the International Freedom of Expression Exchange (IFEX), the network serves as a clearing house. As soon as it receives reports of abuse from any member group, it distributes the information electronically to other members as well as to governments, media, and organizations associated with the case.

"We have created a rapid-response system," says Nicholas Filmore, executive director of CCPJ, which had been using slower and more costly faxes, letters, and phone calls to support the rising number of cases around the globe. Time is of the essence, he says, because "when a journalist or writer is detained, in many countries it is often within the first 72 hours that the person may disap-

pear or be tortured or killed."

Because of the network's speed, coordination, and crisis-oriented nature, Filmore contends, numerous deaths and prison internments have been prevented. For example, American Jeremy Bigwood, a news photographer for Gamma-Liaison, was detained on January 8, 1993 and charged with terrorism by the Peruvian armed forces for photographing Movimiento Revolucionario Tupac Amaru, a Peruvian guerrilla group. Informed of the abduction on January 13, the Action Alert Network immediately sent out a worldwide alert. The threat that major newspapers around the globe would carry the story as well as the rapid involvement of the U.S. Embassy in Peru led to Bigwood's release to the American Embassy two days later, says Filmore. All charges were dropped.

An even more harrowing episode occurred in Haiti on February 1, 1993, when Colson Dormé, a Haitian journalist with Radio Tropic, disappeared after filing a report on investigations by the Organization of American States and the United Nations into human rights abuses in Haiti. On February 3 the network issued an alert and began airing regular radio reports in Haiti on the abduction. Five days later, Dormé was dumped at the radio station. Alive though blindfolded, gagged, and beaten, he avoided the fate of fellow Haitian

journalist Felix Lamy, who has been missing since November, before the network's creation.

Overall, some 300 e-mail alerts have been issued since the network's inception. Besides working with already established Third World professional organizations such as the West African Journalists' Association and the Reporters' Association of Thailand, the Action Alert Network's parent—IFEX—devotes funding and technical expertise for creating new regional centers that facilitate communication of local abuses to the network. IFEX's first such project is the Central American Office for the Protection of Journalists and Freedom of Expression (CEPEX), which maintains offices in Costa Rica, El Salvador, Guatemala, and Nicaragua. "By the end of 1993 most of the Central American

region should be covered," says CEPEX director Byron Barrera.

"The goal is to establish a new regional center every year," says Ali Rahnama, head of the Action Alert Network, "because although IFEX now does more than 90 percent of its communications through e-mail on the Action Alert Network, we must still rely on fax and telephone in regions where computers and networks are too costly or unavailable." IFEX plans to open offices in Moscow and the former Yugoslavia later this year and is considering dozens of other requests from Africa, Asia, and Latin America.

Setting up CEPEX and bringing the West African Journalists' Association online were both fairly straightforward operations thanks to the existence of dependable local phone systems and

computer expertise in each of the regions. However, in parts of Africa, Eastern Europe, Latin America, and especially in Southeast Asia, computer expertise is lacking and telephone lines are costly and of poor quality.

In these regions, IFEX is investigating the possibility of installing satellite ground stations in remote areas to bypass telephone lines completely. It is also investigating wireless communication through packet radio, which transmits computer data in digital form over ham radio in much the same way modems send computer data over phone lines. Like the HealthNet system, which links Third World hospitals and doctors with their First World counterparts—this system would require only a personal computer, radio transmitter, receiver, and antenna.—*BRAHM EILEY*

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TRENDS



Children's Science Radio

Kinetic City Super Crew, an experiment in children's radio created by the American Association for the Advancement of Science (AAAS), has four kids setting out to solve the world's problems with science. To accomplish their missions they travel on a train—complete with resident scientists—that can go anywhere in the world at a moment's notice.

Debuting as four half-hour episodes last spring on several public radio stations across the country—including WILL in Urbana, Ill., and KSER in Seattle, Wash.—the program is designed to interest third, fourth, and fifth graders in the wonders of science. The show's producers are hoping the pilots will prove the value of the program to the National Science Foundation (NSF), which is expected to decide by this January whether to continue funding to create a full year of 39 episodes.

The opening episode, "Time," opens with Claus the clockmaker placing a frantic phone call to the members of Super Crew—Annalee, Joaquin, Chantel, and Alvin, ages 12 to 16. The problem: Claus can't

seem to set his clocks to the right time. Thus begins a half-hour journey that has the Super Crew traveling to a rainforest, where natives tell time by the different sounds that animals

make, and finally to the atomic clock run by the National Institute of Standards and Technology in Boulder, Colo., where the Crew finds and fixes the problem: a practical joker had placed silly putty in the clock's innards.

Along the way, listeners learn how to build a working water clock in their kitchens and hear an interview with people who work the night shift. Kids who want more information can call a toll-free number to get a postcard with a description of the show's experiment; a teacher's guide is also in the works.

But doesn't radio's inability to show diagrams and other visual aids present problems when trying to explain science? "If we really had to teach science, it would be difficult," admits Robert Hirshon, the show's executive producer. "But the purpose of the show is not to give short courses in time, waste disposal, or microbiology—it's to get kids fired up about these topics," he says. "Then maybe when they go to school, they will already be interested in what the teachers are talking about."

One advantage of radio over other media, Hirshon says, is that it is more accessible. Many kids listened to the pilots at home while doing chores or in

A new radio show follows the adventures of the Kinetic City Super Crew as they travel the world on an imaginary train and solve mysteries using scientific investigation.



the car while being chauffeured to an after-school activity.

But to work, the show must be entertaining above all else, says Hirshon; otherwise, kids will just turn it off. That's why each Kinetic episode starts with a mystery entangling a likable character with an interesting problem.

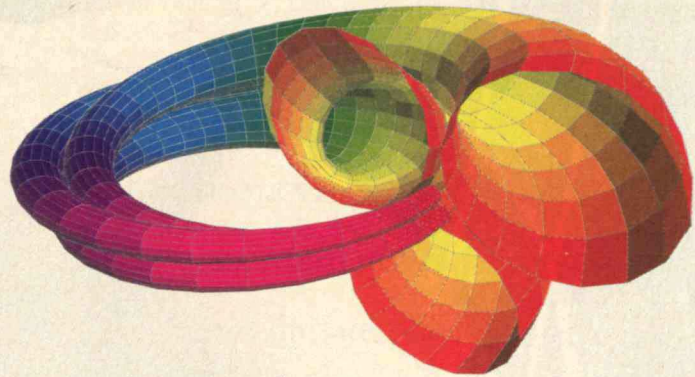
"We also wanted to make sure the Crew represented the listeners," Hirshon says. Because the audience is mostly in urban areas, the students were selected as much for their racial composition—one is white, two are African American, and one is Hispanic—as for their distinctive voices.

To measure the effectiveness of the program's approach, AAAS used part of the \$215,000 NSF grant to conduct focus groups in seven cities around the country. Not surprisingly, children were most interested in the mystery story segment and least interested in segments about adults, says Barbara Flagg, director of Multimedia Research, a New York-based market research firm, who evaluated the results. "In one program's interview with night workers at a hospital, the kids were very aware that this was about adults and adult difficulties, and it didn't appeal to them."

The focus groups weren't designed to show whether the program actually gets kids more interested in science, allows Flagg. But, she says, they do show that kids who aren't interested in science like the program as much as kids who think that science is cool.

Radio executives at the stations are enthusiastic. "It's a new and different approach," says Virginia Carson, chief executive at the Radio Zone, WKDL, in Silver Spring, Md. "It conveys science concepts in a way that's fun." The only problem with the pilots, she says, is their length. "It is not clear that the half-hour format is best for the audience." Kids might not sit still long enough to hear the entire installment. A better alternative, she suggests, might be to air 10-to-15-minute segments that a station could intersperse with other children's programming.—SIMSON GARFINKEL

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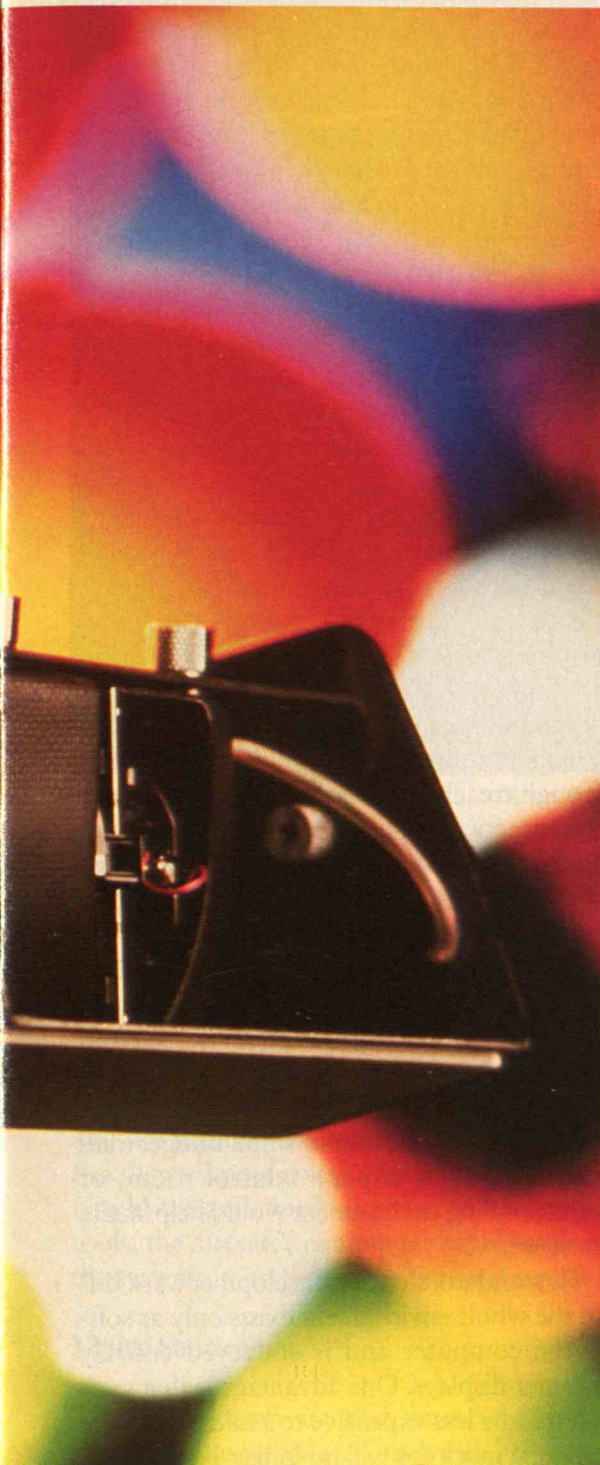


HEAD-MOUNTED DISPLAYS PRESENT A COMPUTER-GENERATED
SCENE THAT SHIFTS AS THE WEARER WALKS AND TURNS.

Check

BY
THOMAS B. SHERIDAN
AND DAVID ZELTZER

New technology lets you boldly go where no one has gone before. But it must make some real progress before you can really believe you're there.



A ROBOTICS engineer stands on the desolate Martian landscape and summons the latest design of her multi-legged rover with a simple wave of her hand. As she puts the walking machine through its paces, using other hand gestures, she finds that it stumbles when climbing down steep rocky grades. Frustrated, the engineer removes the headset and hand controls she has been wearing and instantly finds herself back in her lab, where she goes back to the computer drawing board to find a way to make the rover more stable. ★ As you have no doubt deduced, the engineer in this hypothetical example never really leaves the lab, let alone the planet earth. She has been

PHOTOGRAPHS BY PETER MENZEL

*In animals, a sense of touch evolved long before hearing and vision.
In virtual environments, the reverse is true.*

working in a virtual environment, a computer-simulated world of sights and sounds that changes in response to her actions.

But while this application is fictitious, it is not too many years beyond the capabilities of current technology. In fact, simply by donning today's so-called "virtual reality" gear—goggles with tiny TV screens that show computer simulations, headphones that present corresponding three-dimensional sounds, and gloves with sensors that relay hand movements back to the computer—the wearer can enter and interact with any number of fantastic worlds.

Still, even today's most sophisticated applications, such as NASA's virtual wind tunnel that lets engineers interact with supercomputer simulations to solve aerodynamics problems, do not come close to fully and accurately representing the physical world—real or imagined—being modeled. The systems do not enable users to truly suspend their disbelief of the simulation and experience it as if it were real. But they do show that virtual reality, more appropriately called virtual environment (VE) technology, even in its current embryonic state, is proving not only to be of some value now but, more important, to hold great promise for the future.

In fact, VE research may well be at a stage of development similar to that of the space program of the 1950s: though researchers firmly believe in the value of their work, they have little thus far to show for it and readily acknowledge that a great many technical hurdles must be cleared before the technology can begin to reach its potential.

Yesterday's Realities

Perhaps the most direct precursor of today's VE systems dates from the early 1940s, when entrepreneur Edwin Link, along with Admiral Luis DeFlorez, pioneered technologies for flight simulators that have since been used for pilot training by all major airlines. These systems have become so real in their display images of what would be seen from the cockpit window, and in the way the mocked-up cockpit turns and rolls on a moving platform, that a pilot's first real flight in a new

aircraft model is often with a plane full of passengers.

The first head-controlled viewing systems were demonstrated in 1965 by Raymond Goertz at Argonne National Laboratory and by John Chatten of Motorola. Displaying images from remote, closed-circuit cameras, these were used for viewing inside "hot cells" where radioactive materials were handled experimentally or processed in small batches for use in nuclear power and medicine. Primitive systems for force feedback—to simulate the sense of touch—are now being incorporated in some experimental VE applications. These were also first developed in Goertz's laboratory for remote hot-cell manipulators, and later adapted to simulate hand contact with computer-generated virtual objects.

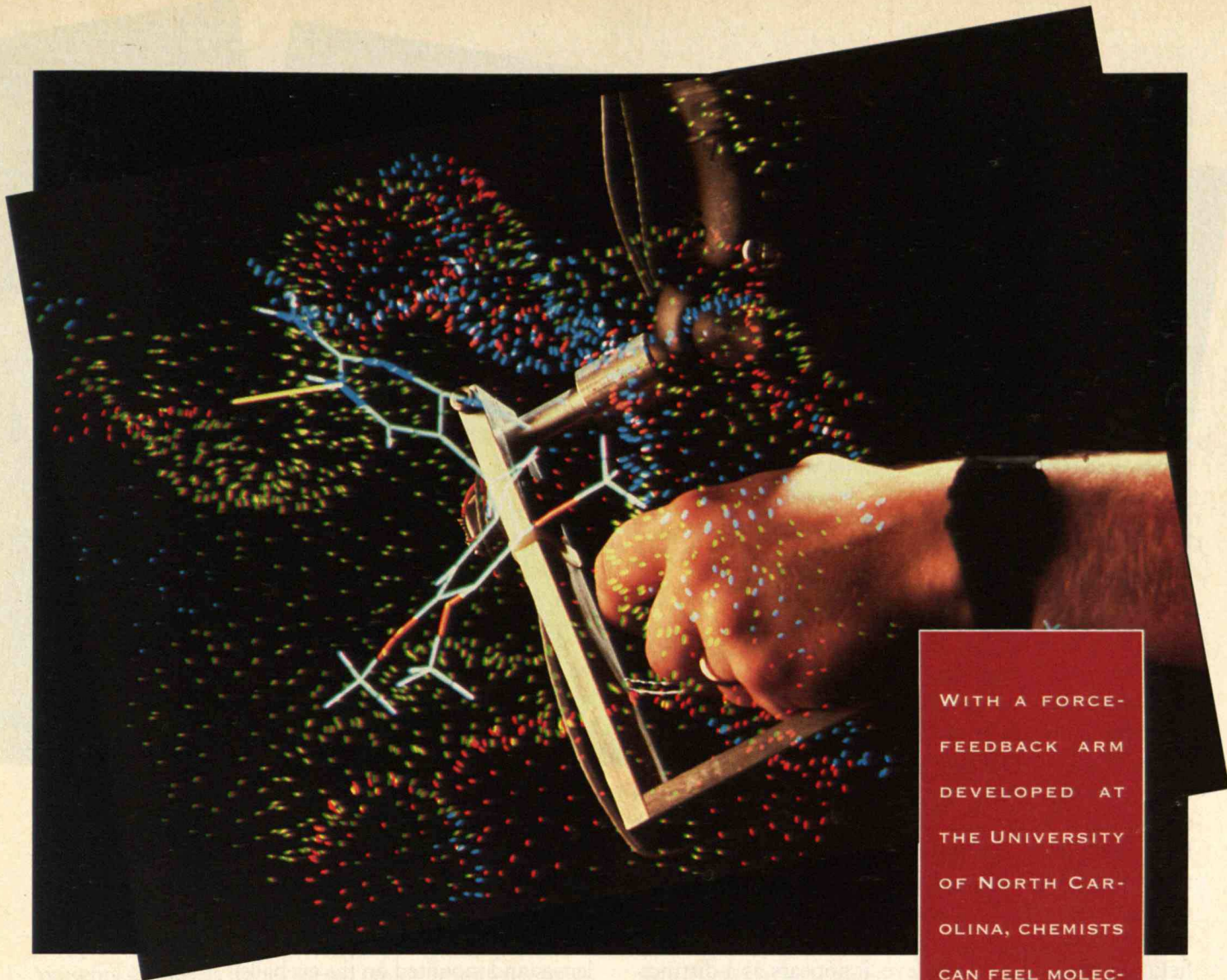
Around the same time, Michael Noll at Bell Labs developed a joystick that, after a fashion, allowed users to "feel their way" around a computer-generated world, bumping into obstacles or moving along the surface of a wall. And in 1968, MIT graduate student Ivan Sutherland, now a vice-president at Sun Microsystems, a computer workstation company, demonstrated a head-mounted display that showed computer-generated images that changed according to where the head turned.

Today computer-based simulators are used not only as flight trainers but also to teach ship pilots how to navigate through treacherous harbors, nuclear power plant crews to practice responses to emergencies, and military officers how to command diverse and distributed resources in battle. Still others are used to train surgeons, anesthesiologists, locomotive engineers, and automobile drivers.

But these are the "older" type of simulators in which the user sits in front of a computer or TV screen and watches the action as if looking through a window. Everything else in the room has been constructed from real materials to look like a cockpit, ship's bridge, military command post, power-plant control room, or whatever corresponding environment would help create a sense of presence.

The new VE simulators under development are different in that the whole environment exists only as software inside the computer and is conveyed entirely through computer displays. One advantage is that such simulators should be less expensive to build and maintain, since physical mockups will no longer be required. These systems would also be portable so that Navy pilots, for example, could practice with simulators onboard their ships rather than wait for the opportunity

THOMAS B. SHERIDAN is a professor in the MIT departments of Mechanical Engineering and Aeronautics and Astronautics. DAVID ZELTZER is a principal research scientist in the MIT Research Laboratory of Electronics. Sheridan is co-editor-in-chief and Zeltzer is an associate editor of the journal *Presence: Teleoperators and Virtual Environments*.



WITH A FORCE-
FEEDBACK ARM
DEVELOPED AT
THE UNIVERSITY
OF NORTH CAR-
OLINA, CHEMISTS
CAN FEEL MOLEC-
ULAR ATTRACTION
AND REPULSION,
SUCH AS WHEN
TRYING TO UN-
DERSTAND HOW
DRUGS AND PRO-
TEINS INTERACT.

to visit a large and expensive land-based simulator.

More significant, the new simulator is reprogrammable. Thus pilots could use it to train in a new fighter jet one day, and aircraft mechanics could practice engine repair on it the next. Pilots and mechanics would all use the same interface equipment for visual, auditory, and force feedback, but the computer models displayed to them would be vastly different: Pilots could see ocean and sky through the cockpit canopy as well as see and feel the cockpit displays and controls, while mechanics would see and manipulate computer models of their tools, the aircraft's equipment bays, hatch covers, and the systems in need of inspection and repair.

Visible Shortcomings

The major component of the new simulators is the head-mounted display. This bulky headset contains a pair of miniature cathode ray tubes (CRTs) or liquid-crystal TV screens—one placed in front of each eye for stereo viewing—as well as magnifying lenses to gener-

ate a wide field-of-view.

The headset also houses sensing devices that measure the position and orientation of the wearer's head and report changes in viewpoint to the computer. The computer then generates pictures—a slightly different view for each eye—that the observer sees corresponding to his or her eye position and orientation in the actual world. What he or she then observes ranges from the near-real to the decidedly imaginary. The user can not only walk through doorways or crawl through holes, but can defy gravity and fly through an artificial world.

The kind of computer simulations that could ultimately be shown on head-mounted displays have become much more realistic. Image quality, resolution,

and the speed of updating pictures have improved rapidly every year for the past 10 years, driven in large part by entertainment media, as well as by hardware and software advances by industry and university research groups. At the same time advances have been made in simulating how limbs move as people and animals walk, and how natural and manufactured objects appear to the eye. Thus although modeling and display techniques are still lacking for many common objects and phenomena, such as clothing, skin, hair, clouds, smoke, and fire, in some cases computer animations, such as the dinosaur sequences in the hit movie *Jurassic Park*, can be compellingly realistic.

The bad news is that such highly realistic computer animations can't be used for VE. Even a single frame of so-called photo-realistic animation requires lengthy computing times on today's workstations, yet computer-generated displays must be updated in real-time as the wearer of a head-mounted display moves and turns.

Today's head-mounted displays are problematic in other ways. In good light, the human eye can discriminate details as small as one-half to one minute of arc—roughly a half-inch from 100 yards away. But the liquid crystal displays (LCDs) used in virtual-reality headsets offer only one-tenth this resolution, showing details equivalent to 5 inches at 100 yards. The problem is that LCD images are composed of individual pixels—the many light-dark dots on the screen. To make matters worse, when an LCD image is viewed through the optics needed to match the nearly 180-degree-by-120-degree field of view of the human eye, it appears as a distracting texture of dots rather than a smooth, continuous picture.

Miniature cathode-ray tube (CRT) screens, used in some head-mounted displays, can provide better resolution, roughly 3 1/2 inches at 100 yards, but at the expense of color. This is because color TV sets can't be made small enough to fit in head-mounted displays—one color pixel requires the screen space of three monochrome pixels, one for each of the three primary colors.

Advances in the realism and responsiveness of head-mounted displays will continue at a steady pace, as VE developers take advantage of ever-faster processors and more effective algorithms for displaying computer-created images. But innovative techniques designed expressly for VE systems may speed the process. One promising approach is to incorporate eye-tracking devices in the head-mounted displays. That way, if the computer knows exactly where the eyes are looking on the display screen, it will have to generate a high-resolution image only for the small area that our eyes are able to focus on. Leaving the area in our peripheral



vision at low resolution—which is not really in sharp focus anyway—would thus reduce the computational burden on the graphics processors and speed the display's response time. Ideally, such eye-position-based displays could be shrunk to the size of a pair of contact lenses and mounted on the eyeballs.

Unsound Sound

We know from experiments that when multiple senses tell us the same thing, information is more believable. In VE systems, this phenomenon is most apparent when sound is used to accompany a visual display. Several companies offer systems that present sound that corresponds to the action taking place in a virtual world. Like stereo systems, these devices exploit the ability of our ears to measure subtle time and amplitude differences of sound patterns that reach the two sides of our head at slightly different instants. But unlike stereo sound, which allows listeners to pinpoint sound sources only along the horizontal plane of two or more speakers, these devices enable listeners to identify where a sound is coming from and how it is moving in three dimensions.

Some new VE systems that synthesize three-dimensional auditory space incorporate a digital-signal processing device such as the Convolvotron, developed at NASA Ames Research Center and Crystal River Engi-



neering. The user wears a head-mounted display to view the visual presentation as well as hi-fi earphones plugged into the Convolvotron to hear sounds that correspond to the graphics. Essentially the auditory equivalent of the head-mounted display, the Convolvotron presents sounds as if they were coming from fixed locations and maintains those locations even when the participant turns or walks around.

To simulate a sound coming from somewhere overhead, the Convolvotron takes into account the important role that the head and the fleshy, outer-ear appendages, called pinnae, play in the process. By placing microphones in the ear canal of test subjects and recording sound patterns before and after they were altered by the head and pinnae, researchers developed mathematical functions and applied them to sounds played through the Convolvotron's headphones to simulate the effect.

One VE system that presents both visual and auditory information is being used as a high-tech sales tool in a kitchen showroom of Matsushita Electric Works in Tokyo, where the shopper "walks" through any of a number of virtual kitchens. Users can look around, move things, and hear realistic sounds of cabinets opening and closing, water dripping, glasses being set in the sink, even dishes breaking precisely where they are dropped on the floor.

Still, serious challenges remain for those wish-

ing to accurately simulate sound. For instance, although today's systems can precisely represent the location of a sound source near the horizontal plane, representations of sounds coming from overhead are less accurate. Also, the sound systems are not able to portray the subtle details and variations of sounds reflected off surfaces such as brick walls, carpets, and pavement. Moreover, pragmatic issues such as time delays in the computer's signal processing contribute to the lack of realism in virtual auditory worlds.

Researchers are currently refining the mathematical functions used in the Convolvotron to more closely simulate, or even exaggerate, the way the head and outer ears

RESEARCHERS AT
STANFORD (LEFT) ARE
DEVELOPING A "VIR-
TUAL CADAVER" PRO-
GRAM TO ENABLE STU-
DENTS TO MANIPU-
LATE ANATOMICAL
STRUCTURES AT WILL.
DEVELOPERS AT THE
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SION A SYSTEM IN
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A "FLY-THROUGH"
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SUCH AS THIS PRO-
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AND FIXTURES.

scatter sounds to enhance a VE participant's ability to pinpoint sound even further, perhaps even beyond normal abilities. But synthesizing reflected or reverberating sounds is a far more difficult proposition. Because simulating every sound wave that ricochets off every object in a real environment is such a complex computational problem, we cannot even begin to deal with it in real time. Thus, for the foreseeable future, the most realistic sounds will not be computer generated but sampled, or pre-recorded, sounds that the system will play when given the appropriate cues.

See Me, Feel Me

Systems using joysticks, tool handles, or steering wheels have for some time done a reasonably accurate job of simulating gross force feedback to the sense organs in our hands. The early force-reflecting manipulators built by Goertz and the experimental joystick of Noll, for example, both present the sum of forces acting upon them by pushing back on the user's palm or fingertips, just as modern automobile power-steering systems incorporate gross force feedback to allow us to "feel" the road and the force of turning.

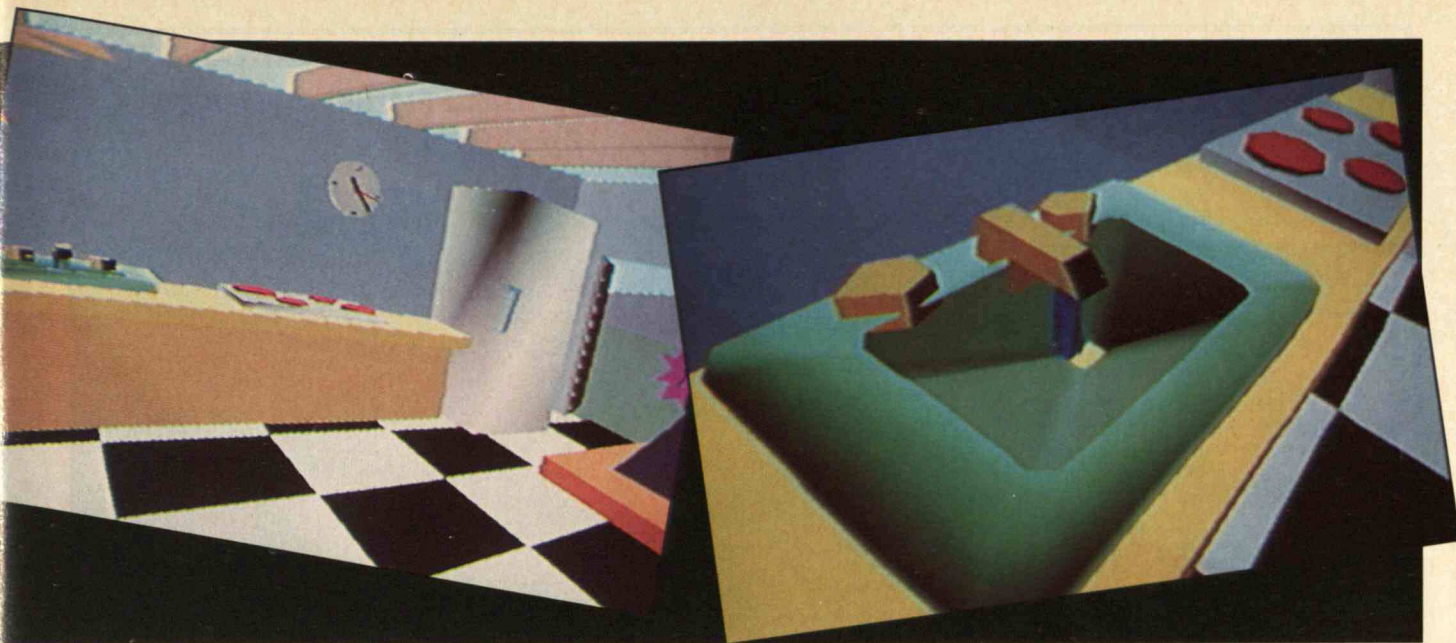
A unique gross force-feedback system is even being used in a virtual environment by Fred Brooks and his

colleagues at the University of North Carolina to explore the interactive forces between molecules. Wearing a head-mounted display and holding onto a computer-controlled moving arm with a hand grip, an organic chemist can observe large virtual molecules, reach out and manipulate them, and feel the forces of repulsion or attraction when trying to fit them together. While no one really knows how molecules look and feel, these scientific simulations are nevertheless providing chemists with insights into the structure and behavior of molecules they would not otherwise get by simply viewing the structures on a computer display.

But while it is common to provide gross force feedback to the organs in our muscles, tendons, and joints, a method of accurately simulating spatial patterns of forces to the surface of our skin still evades us. One reason simulating cutaneous touch is so difficult is that the variety of sense organs just below the skin surface are sensitive only if the force pattern is continually changed, for example, by actively moving the fingers over some object or surface texture.

Researchers have tried many different approaches to impressing computer-driven touch patterns on the skin: jets of air, direct stimulation of the skin by electric current, and piezoelectric vibrators with crystals that flutter mechanically when alternating current is applied. In fact, many of these approaches have been explored for decades by bioengineers seeking to provide blind persons with a means of reading and navigating. But none has proven satisfactory, and none has come close to the tactile equivalent of the video display.

Some work has begun to develop virtual displays for touch. For example, MIT graduate student Nicholas Patrick recently demonstrated that it's possible to reach out to an object that exists only in virtual space and



receive a tactile sensation corresponding to the measured hand position. And Margaret Minsky of the MIT Media Lab is experimenting with a force-feedback joystick that allows a user to feel simulated textures on virtual surfaces.

But getting beyond crude forms of simulating cutaneous feedback in combination with corresponding gross force feedback remains the most difficult of all challenges currently facing VE system designers. Generating the delicate spatial and temporal patterns of mechanical forces that suitably mimic what is felt when handling a pencil, running a finger across a textured piece of cloth, or tapping a hard surface with the fingernail would require using a large number of unobtrusive motors or other actuators to accurately deform the skin at each of hundreds of closely spaced points according to a computer program of what should be felt. Further, to place those motors in a glove would require that they be far smaller, lighter, more accurate, and quicker to respond than any currently available.

It has been said that as lower life forms evolved into animals, the sense of touch developed first, while hearing and vision came much later. Technological development seems to have done the reverse: We have high-fidelity sound for the ears and television for the eyes. We even have good systems for relaying gross force feedback from a remote hand back to the operator's hand. But an accurate means of generating artificial patterns of touch on the skin does not exist.

Yet while generating a realistic, synthetic sense of touch may take many years, it may be possible to find a shortcut by involving other senses as a substitute. For example, VE researchers are experimenting to find out whether generating an audible click when one's virtual hand contacts a virtual table, may in some cases be a

useful substitute for accurate force feedback.

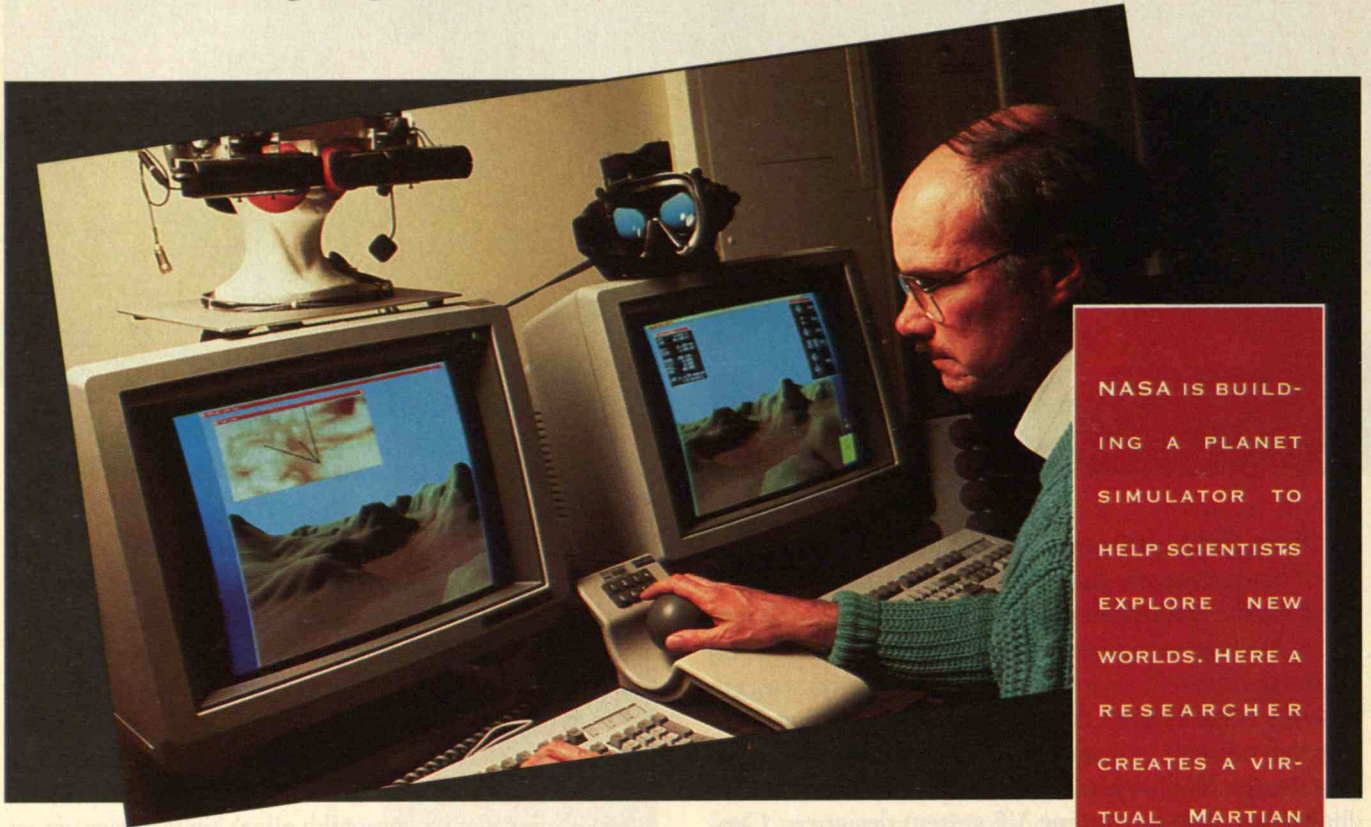
It may not even be necessary to provide much spatial detail to the skin. Researchers in computer graphics and the flight-simulator industry have known for years that many visual details are imperceptible when objects are moving quickly across our field of view or when objects are far away. Most flight simulators, therefore, support several levels of detail for objects: When another aircraft first enters the pilot's field of view from a distant location, the computer displays just a small moving dot. As it approaches, the small blob sprouts projections for the wing and tail surfaces. But not until the computer determines that it's close enough, is the craft displayed in any detail. Similarly, because skin sensations require forces that are continually changing, temporal changes may serve as a substitute for spatial changes. As long as the sensations occur at the right time and magnitude, it may not matter whether the location of the force is accurate.

VE: The Next Generation

The shortcomings of today's VE systems mean that it will be many years, if ever, before a computer simulation will be indistinguishable from physical reality. But that doesn't mean that the technology, limited though it may be, won't be used more widely and effectively.

One application that shows signs of rapid development is operator training. For example, the Electric Power Research Institute is sponsoring work at the MITRE Corporation to develop a fully interactive nuclear power-plant control room simulator presented through a head-mounted display to help teach operators emergency procedures. And in a less serious application, but one that will no doubt help advance the state of the

Like the space program in the 1950s, research on virtual environments holds great promise but has little to show for itself so far.



NASA IS BUILD-
ING A PLANET
SIMULATOR TO
HELP SCIENTISTS
EXPLORE NEW
WORLDS. HERE A
RESEARCHER
CREATES A VIR-
TUAL MARTIAN
ENVIRONMENT
USING DATA AC-
QUIRED FROM THE
VOYAGER FLYBY.

art for other purposes, researchers at the NEC Laboratory near Tokyo are developing an experimental VE system to train skiers. Here, the skier stands on a platform in front of a huge projection screen that shows a simple computer-generated model of a ski slope. While the skier twists and turns down the imaginary slope, two force plates in the platform measure the pressures exerted by each foot and signal the computer to update the screen display accordingly. As the skier holds onto two rigid ski poles fixed to the training platform, a tiny cuff attached to the right index finger measures blood-flow. If the bloodflow is slow and steady, the computer assumes the course is not challenging enough and makes the slope steeper. If bloodflow is strong and rapid, the computer assumes the skier is nervous and struggling and makes the slope more gentle.

Also on the drawing board are novel applications in engineering and science. For example, NASA is creating a VE simulator for planetary exploration that will enable scientists to obtain data from planetary fly-bys and, much like the robotics engineer in our opening example, conduct experiments on the surface of a world on which no one has ever set foot. And Boeing is building a VE laboratory to design and test new aircraft models long before physical prototypes exist. Engineers can

not only see how well the components fit together and the entire aircraft functions, but they can also evaluate the human-factors aspects of the design, including the layout of the cockpit's displays and controls and the cabin's comfort and safety features.

Perhaps the most imaginative VE environment enables the user to control the limbs and head of a synthetic creature moving around in a virtual world. In lab experiments at VPL Research, the firm that commercialized head-mounted displays and gloves, several users became different creatures in the same environment and raced, wrestled, and embraced each other. A player could not only view the virtual world through the eyes of his or her creature, but could choose to see it from any other location, including the eyes of the creature someone else was controlling. Such a capability has profound implications for a variety of uses—including entertainment, product design, scientific research, even psychotherapy—in that it could someday allow us to experience a variety of physical and social interactions not only through our own eyes but those of another. ■

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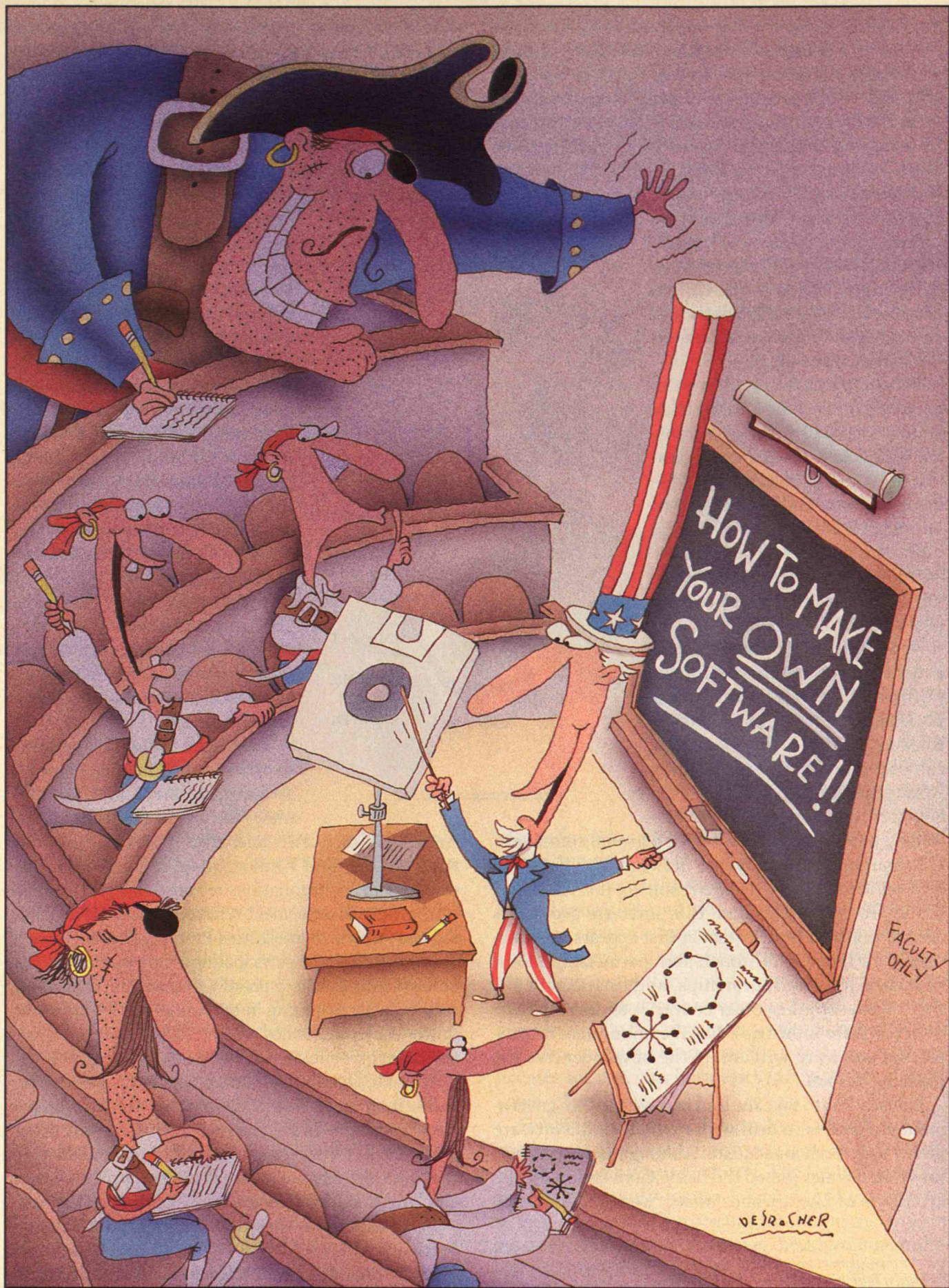
Phone orders normally shipped next business day. Higher shipping/handling outside U.S.

Subduing Software Pirates

BY SUZANNE P. WEISBAND AND SEYMOUR E. GOODMAN

TO PROTECT
THEMSELVES
IN COUNTRIES
WHERE PIRACY
RUNS RAMPANT,
U.S. MANUFAC-
TURERS SHOULD
ENCOURAGE THE
DEVELOPMENT OF
INDIGENOUS
SOFTWARE.

THE case of the counterfeit Microsoft software started in Taiwan with the discovery of supposedly unforgeable metal stickers designed to identify manufacturer's retail packages as genuine. Investigators followed a trail through Japan, Hong Kong, Australia, and China, finding flawless copies of manuals, packaging, and, most important, diskettes for MS-DOS, Microsoft's basic operating software and its hottest product. Some 450,000 phony stickers were traced to a Chinese government-owned research institute that had orders for 3 million more. Microsoft estimates that the ring responsible for the counterfeiting may have copied up to \$150 million worth of MS-DOS. ♦ Software piracy—defined here as the direct, unauthorized copying of a program for comm-



ercial gain—is common throughout the world. Cuba maintains a National Software Interchange Center where copies of all kinds of foreign software are available to any Cuban citizen free of charge. Hardware dealers in Paraguay often try to make a sale more attractive by including bootlegged copies of software. In some Asian countries, including China, South Korea, and Taiwan, more than 90 percent of all U.S. microcomputer software in use is thought to be pirated. Some 80 percent of software employed in Italy has been illegally copied. Even in the United States, where piracy is relatively low, an estimated 40 percent of business software is copied illegally.

But addressing the problem is difficult: what one person calls piracy another may call technology transfer. Wide access to software is essential for rapid economic development—a faster and greater flow of information both improves existing industries and makes possible the creation of new ones. Moreover, in nations where the most pressing problems include dealing with civil strife and providing adequate food and shelter, Western concerns about protecting software often take a back burner. In any case, a single software package in many countries can cost more than a middle-class worker makes in a month.

Unfortunately, as the world's leading producers of software for personal computers, U.S. manufacturers may lose between \$9 billion and \$12 billion annually to the resulting international piracy. To reduce this loss, U.S. software producers need to pursue a strategy that at first appears to undermine their interests. Through joint partnerships, local branches and distributorships, and financial deals, they must encourage other countries to develop their own software industries. Local commitment to protecting software will create the best incentive for reducing its theft.

Industry has to take the lead because the U.S. government's attempts to deal with international software piracy have been inadequate. Although four years ago the United States joined the Berne Convention for the Protection of Literary and Artistic Works—an interna-

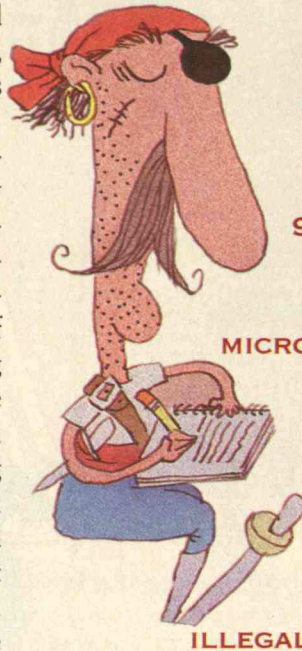
tional copyright treaty—the convention does not include effective provisions for challenging member countries that fail to protect authors' rights.

No Sanctions To Date

The U.S. Trade Act was amended in 1988 to allow trade sanctions, limiting what the United States will either sell or accept, against foreign countries that do not protect U.S. intellectual property rights. But so far, opponents such as the American Association of Exporters and Importers, concerned that sanctions would spark retaliation against other U.S. goods, have pressured the government not to penalize any country. Extending most-favored-nation status to China and maintaining good relations with countries in the former Soviet Union have also seemed to take priority over sanctions. Even the 1991 decision by Carla Hills, then the U.S. Trade Representative, to place India, Thailand, and China on a "watch list" (because of large-scale copyright violations) resulted in no apparent change in those countries' rampant piracy.

The United States has attempted to clarify software owners' rights and enforcement mechanisms under the auspices of the General Agreement on Tariffs and Trade (GATT). After one round of the GATT talks collapsed—for other reasons—in 1990, negotiations resumed this past January on a proposed agreement referred to as TRIPS (Trade Related Aspects of Intellectual Property Rights). But it is doubtful that all the participating countries would agree on such a document, especially since certain developing countries participating in the talks—led by India and Brazil—have questioned whether GATT is an appropriate forum for defining such rights.

Thus far, U.S. software companies have done considerably more to curb software copying abroad than has the government. Today almost all major software developers employ lawyers and antipiracy specialists who conduct copyright enforcement campaigns; the companies have also joined forces, lobbying through the Software Publishers Association (SPA) and the Business Software Alliance (BSA). Although the SPA works largely within the United States, it sometimes extends its



SUZANNE P. WEISBAND and SEYMOUR E. GOODMAN are professors of management information systems at the University of Arizona's College of Business and Public Administration.

efforts overseas. The BSA, representing eight major U.S. software companies, works with law-enforcement officials in more than 30 countries to bring lawsuits against firms suspected of copying. The BSA has also recently cracked down on electronic bulletin board systems that are illegally distributing copyrighted programs to subscribers, who use a modem to "download" them to their computers.

The Best Protection

But heavy-handed tactics alone will not have a lasting impression in countries where piracy is the norm, unless software publishers help foreign governments understand why it is in their interest to confront the problem. Users unwilling to pay for software developed in the United States are typically unwilling to pay for software developed locally. Publishers can also argue that the illegal transfer of technology will not promote the industrial training necessary to encourage indigenous innovation in the first place.

Consider the experience of Sirish Patel, a civil engineer in Bombay who owns an architectural-engineering firm. In the mid-1980s, after developing software for his company, Patel started a second venture to market his program. When he recognized that there would be widespread illegal copying of his software by his Indian engineering competitors, he stopped developing the product.

Realizing that rampant software piracy must stop if India is to develop an indigenous software industry, Patel has formed the Indian Federation Against Software Theft (InFAST), hoping to strengthen enforcement of his country's copyright law. While the law now provides for heavy penalties for chief executive officers of companies caught pirating software, Indian courts have yet to take any action against these individuals. InFAST has proposed concentrating instead on lower- and middle-level managers—penalizing the people who are in a position to know about violations. InFAST maintains that if managers are convicted of producing or possessing pirated software, they should be sentenced to at least one day's imprisonment plus a fine of at least 100 times the price of a single copy of the software.

InFAST is not a singular phenomenon. Software

developers throughout the world, from Uruguay to Singapore, are starting to join in campaigns for better protection for their products. And to enhance their reputations as favorable climates for foreign investment, some governments have begun joining forces with the Business Software Alliance to enforce software copyrights. For example, in 1991 the Malaysian government and

BSA together raided computer dealers suspected of selling pirated software.

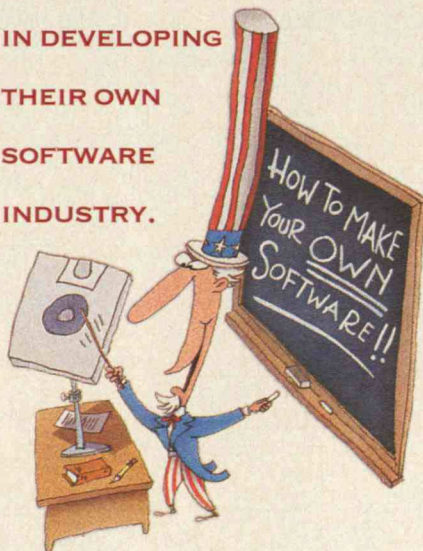
U.S. software producers could encourage this growing awareness—and help themselves—by setting up joint ventures in these countries. As a model, companies could follow the successful examples of this practice in industrialized nations. Microsoft, for instance, has formed joint ventures with several Japanese firms to develop software. Establishing branches in nations with widespread piracy could help as well. Several U.S. firms, including IBM, Sun Microsystems, and Hewlett-Packard, have opened offices or factories in China or have announced intentions to do so. And arranging local distributorships would be wise. After setting up local video distributorships worldwide, the movie industry found that video piracy dropped dramatically. Such actions would

create domestic incentives to protect software and report computer piracy.

U.S. firms could also discourage theft and gain access to local companies and users by setting more affordable software prices for businesses in developing countries. For example, Microsoft reduces the cost of its software for Indian computer-hardware manufacturers who want to ship the company's programs with their products. And using the same tactic as textbook publishers, software manufacturers could lower the costs of site licenses for overseas businesses interested in multiple copies of programs.

Finally, U.S. software companies or the U.S. government could even assist countries interested in developing their own software industry. The United States has offered similar aid—for developing many kinds of businesses—in Eastern European countries in the hope of teaching them about capitalism. The idea could ultimately benefit the donors. ■

AMERICAN SOFTWARE COMPANIES OR THE GOVERNMENT COULD ASSIST OTHER NATIONS IN DEVELOPING THEIR OWN SOFTWARE INDUSTRY.



*Hundreds of scientists
are studying the Grand Canyon to determine
how best to preserve it.*

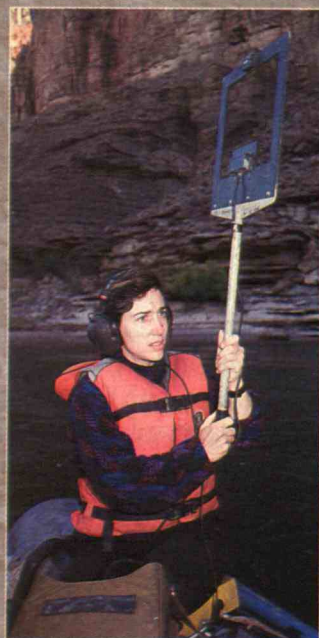
STORY AND PHOTOGRAPHS BY PATRICK CONE

Deep in

MORE THAN 100 YEARS AGO MAJOR JOHN WESLEY POWELL mapped the Grand Canyon's depths, assisted by only eight men. In the past decade hundreds of scientists have again studied this section of the Colorado River, partly to prepare an environmental impact statement (EIS) scheduled to be filed with the U.S. Environmental Protection Agency in October 1994. The EIS is supposed to indicate the extent to which the Glen Canyon Dam—completed in 1963 some 16 miles upstream of the head of the national park—has altered water levels, temperatures, and the amount of sediment flowing down the river, thereby disturbing beaches, archeological sites, and plant and animal life. The U.S. Bureau of Reclamation will use this information to consider more benign ways to operate the dam.

Scientists have also been studying air quality, backcountry use aircraft restrictions, and tourist facilities to help the National Park

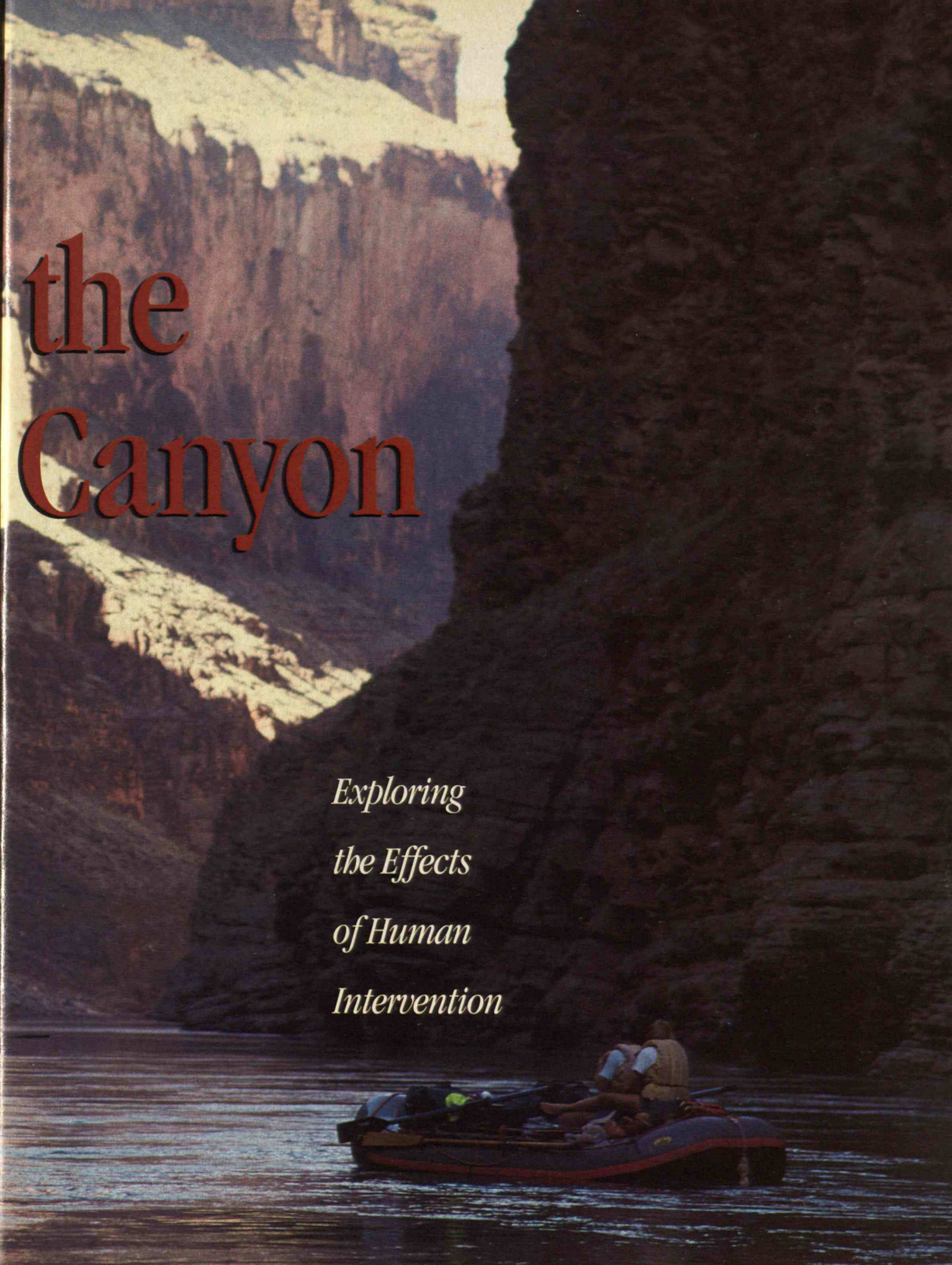
Service prepare a Grand Canyon general management plan, which should also be released in 1994. Overall, more than 100 scientific projects have recently been conducted in the region, which is visited by 4 million people annually. The detailed research indicates the level of public concern raised about the future of the Grand Canyon and the rapidly developing Southwest.



**INSET: ON THE COLORADO RIVER AT THE
BOTTOM OF THE GRAND CANYON, BIOLOGIST
LESLIE BROWN USES A PADDLE-LIKE DIREC-
TIONAL ANTENNA AND HEADPHONES TO
TRACK FISH SURGICALLY IMPLANTED WITH
TINY RADIO TRANSMITTERS.**



ILLUSTRATION: MARIANNE FILBERT

A photograph of a person in a raft on a river in a canyon. The person is wearing a life vest and is positioned in the lower right of the frame. The river is calm, reflecting the surrounding cliffs. The canyon walls are steep and rugged, with a mix of dark and light rock formations. The lighting suggests a late afternoon or early morning setting, with long shadows and warm tones. The title 'the Canyon' is overlaid on the left side of the image in a large, red, serif font.

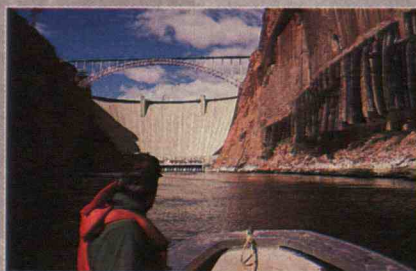
the Canyon

*Exploring
the Effects
of Human
Intervention*

CONSIDER the effort that has gone into the EIS for the operation of the Glen Canyon Dam, which controls spring floods, stores water for agricultural and urban uses, produces inexpensive power during peak demand, and makes possible a variety of recreational activities at Lake Powell, the artificial lake behind the dam. In 1989, recognizing that the dam created enormous daily tide-like fluctuations in the Colorado River, Manuel Lujan, then U.S. Secretary of the Interior, ordered an EIS for use in suggesting alternative water releases. (To supply peak summer power for such purposes as running air conditioners in Phoenix and Tucson, more than 31,000 cubic feet per second of water had to flush the canyon—five times the water-release level at night. Two years ago, Interior ordered dam operators to moderate the maximum water releases by about a third, at least until the EIS is finished in 1995.)

To precisely map the region and thus begin to understand the dam's effects, scientists have used traditional solar reckoning, historic surveys, and the satellite-based Global Positioning System. They started by pinpointing the exact positions of dozens of geographic points that could serve as a baseline for further mapping. Surveyors have also mapped the river bottom's contours with a sonar system carried on inflatable boats. The data have been fed into a geographic information system, a computerized database and clearing-house representing all the scientific research in the canyon.

Biological research has helped determine how the river's ecosystem has changed since 1963. Before the dam, raging spring floods from the Rockies' snow melt sent up to 200,000



A THE COLORADO RIVER HAS CHANGED DRAMATICALLY SINCE THE GLEN CANYON DAM, RISING ALMOST 600 FEET ABOVE THE RIVER BOTTOM, WAS BUILT 30 YEARS AGO.

B AT VARIOUS SPOTS IN THE GRAND CANYON, SURVEYORS PLACED LARGE PLASTIC IMAGES REPRESENTING THE LETTER "X." THESE WERE VISIBLE IN PHOTOGRAPHS TAKEN FROM AIRPLANES. THE MARKS HAVE BEEN USED TO HELP MAP THE REGION PRECISELY.

C SCIENTISTS HAVE SEINED AND

D USED MINNOW TRAPS TO FIND THE ENDANGERED HUMPBCK CHUB.

E BIOLOGIST BRIAN COWDELL COLLECTS RIVER ALGAE TO STUDY THE CHUB'S FOOD WEB.



PATRICK CONE, a science and travel photographer/writer based in Oakley, Utah, has worked as a helicopter navigator on geophysical and mineral surveys.



B



C



D



E



F

F CRAMMED ALONG A LEDGE OVER THE LITTLE COLORADO RIVER, HYDROLOGISTS INSERT A ROD FOR GAUGING THE RIVER'S HEIGHT AND USE OTHER INSTRUMENTS TO STUDY ALKALINITY, TEMPERATURE, TURBIDITY, AND FLOW.



dam has greatly reduced the volume of sediment carried by the river, which once created wide beaches and supported aquatic life that thrives in turbid environments. The dam has also dropped water temperatures from a maximum of about 82 °F before 1963 to a maximum of some 54 °F today. The dam's intake

cubic feet per second of water coursing down the canyon, preventing the growth of most perennial riverside vegetation. But three decades of flood control have enabled marsh plants and trees to find footholds along the river. Moreover, the

pipes, 230 feet below the lake's surface, are in a region where the water stays quite cold.

The result is that the river is now a perfect habitat for rainbow trout—introduced in 1964 by the Arizona Department of Game and Fish—which in turn have attracted bald eagles in winter. While some birdwatchers and fly fishers love this situation, some native species could be losing out. Take the case of the humpback chub, an oddly shaped two-pound fish that can live up to 30 years and is on the endangered species list because it exists only in the systems of the Colorado River and the adjoining, more northerly Green River. Locals today claim to rarely see the chub in the Colorado, which was once so common that boaters used it for food. To acquire solid information about chub populations, biologists have spent more than two years tracking the fish in the Colorado.



The chub studies exemplify the breadth of research undertaken to develop a complete environmental impact statement. To examine a tributary used as a spawning area, for instance, last November scientists converged at the spot where the Little Colorado River empties its warm, turbid waters into the Colorado. Having previously implanted adult chub with radio transmitters for 24-hour tracking, biologists tried to locate individual fish using headphones, paddle-like directional antennae, and a solar-powered omnidirectional antenna. The biologists also hand-seined and “electrofished”—placing electrodes into water to stun fish so that they floated to the top—and checked minnow traps for chub fry.

Such work led Biowest, a fisheries contractor for the Bureau of Reclamation, to report this past spring that it had captured only about 2,000 chub from October 1990 through November 1992. The biologists reported

that the Colorado’s “water temperature was too low for successful reproduction by humpback chub” and also “probably limits survival of young fish descending from warm canyon tributaries.” The scientists did not say how the change in turbidity affects the chub, although they pointed out that the fish use turbid water “as cover for safety during feeding as well as against predation.” The damming, the report claims, partly led “to a slow reduction in numbers” of chub, based on the few historic records available.

Other studies hint at the extent of the research in the Grand Canyon, too. For instance, also in the area of the Little Colorado River, hydrologists and others have collected data for building models of that river’s turbidity, water quality, alkalinity, and flow patterns. Such “modeling has never been done before on such a complex river system” as the Colorado, says National Park

Service biologist Larry Stevens. The information, which includes erosion and soil-deposition data obtained from photographs automatically taken daily by cameras placed high above the river, have helped to confirm that the 1991 decision to moderate water flow has stabilized previously eroding beaches.

As the data-collection phase of the EIS came to a close this past spring, the Bureau of Reclamation began weighing different ways of releasing water from the dam. According to Tim Randle, a manager with the bureau's Colorado River Studies Office (CRSO), the preferred option is to mimic the river's original behavior by combining larger releases in springtime with a consistent daily flow rate and a release every 5 or 10 years that would be significant enough to simulate a major storm. The dam would still release the same amount of water overall and produce as much power, but other generating plants would have to supply peak power.

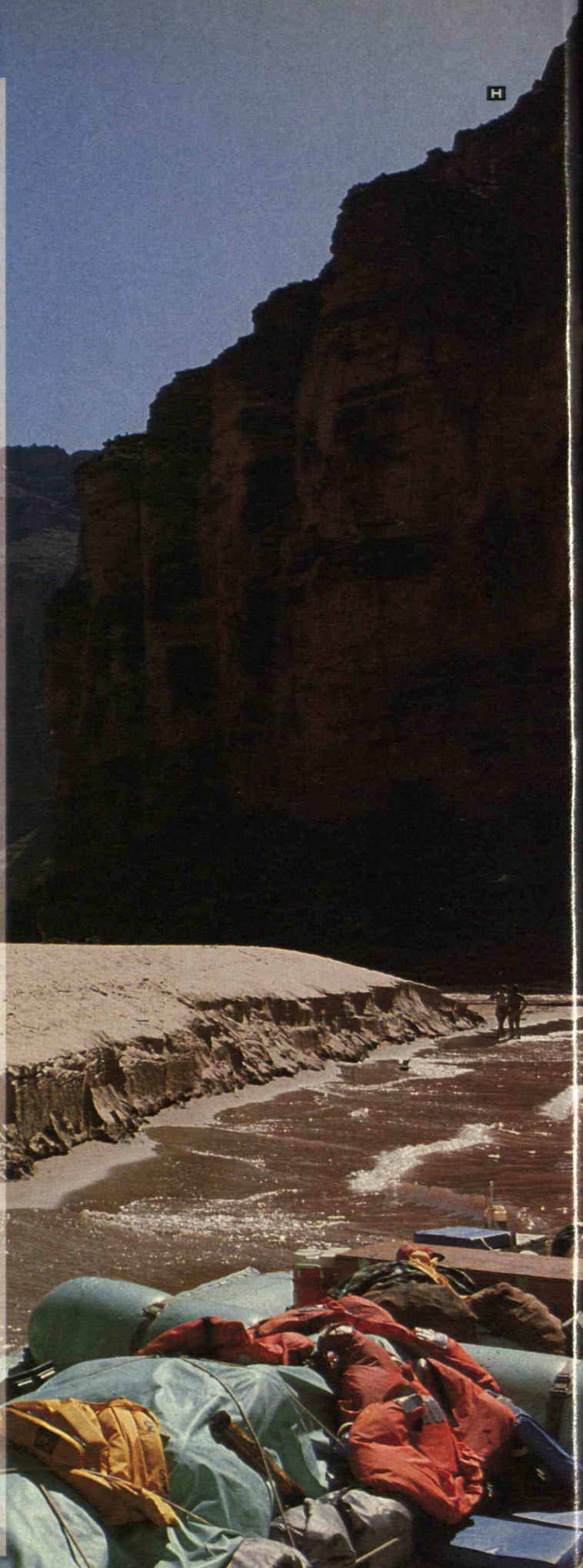
The bureau is continuing to study whether to build different kinds of water intake structures that could send warmer water through the canyon, says Lee McQuivey, CRSO program manager. But alternatives to increase the movement of sediment throughout the canyon are not being considered because of their cost.

Aquatic biologist Michael Yard of Glen Canyon Environmental Studies, a research consortium involving scientists from the Bureau of Reclamation, National Park Service, and other government agencies, sees the EIS-related research as the first step in properly managing the section of the Colorado River that lies within the Grand Canyon. By identifying "what resources are critical," he says, scientists can "continue to monitor them long after the EIS is released." ■



G HIGH ABOVE THE RIVER, WORKERS CHECK A CAMERA USED TO OBTAIN DATA GATHERED ON EROSION AND SOIL DEPOSITION.

H EROSION CAUSED BY SUDDEN CHANGES IN THE COLORADO RIVER'S WATER LEVEL WAS OFTEN SEVERE BEFORE FLOWS WERE MODERATED IN 1991.



MIT

OCTOBER 1993



GETTIN' DOWN AT REUNIONS

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COVER

The "young classes"—the grads of 1978, '83, and '88—held their big reunion bash at the World Trade Center on the Boston waterfront. A few of the attendees were heard to comment that it wasn't such a fun party. But when we scanned the photos like this one, it sure looked like some people were having a great time. Photo by L. Barry Hetherington



ALUM- NEWS

MIT Elects 13 to Corporation

The MIT Corporation elected 13 alumni to membership at its quarterly meeting May 28.

ELECTED LIFE MEMBERS

HERBERT H. DOW, 2ND, '52. Dow was born in Midland, Mich., in 1927 and received the SB in general engineering from MIT in 1952. He joined the Dow Chemical Company in 1952 and retired in 1992, serving at different times as director, corporate secretary, and VP. He has been president of the Herbert H. and Grace A. Dow Foundation since 1970 and president of the Herbert H. and Barbara C. Dow Foundation since 1957.

ANGUS N. MACDONALD, '46. Born in 1926 in Baltimore, Md., MacDonald received two degrees from MIT: the SB in aeronautics and astronautics in 1946 and the SM in mechanical engineering in 1947. Specializing in the initiation and negotiation of corporate mergers and acquisitions, MacDonald has been president of Angus MacDonald & Co., Inc., of Greenwich, Conn., since 1970.

RAYMOND S. STATA, '57. Stata was born in 1934 in Coatesville, Pa., and received both the SB and SM degrees in electrical engineering from MIT in 1958. One of the founders of Analog Devices, Inc., in

1965, Stata was president of the company from 1971 to 1991. He has been chair since 1973.

ELECTED TO FIVE-YEAR TERM MEMBERSHIPS

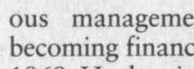
DONALD J. ATWOOD, '48. Born in 1924 in



Haverhill, Mass., Atwood received the SB in electrical engineering from MIT in 1948 and the SM in 1950. He then joined the technical staff of MIT's Instrumentation Laboratory and participated in

its inertial guidance development program. In 1952 he became treasurer and chief engineer of the Dynatrol Corp., and when the company was acquired by General Motors in 1959, he assumed the first of a number of management positions at GM. He was vice chair of the board at GM when President Bush named him to be deputy secretary of defense in 1989.

WILLIAM S. EDGERLY, '49. Born in 1927 in Lewiston, Maine, Edgerly received the SB in economics and engineering from MIT in 1949 and an MBA from the Harvard Business School in 1955. In 1952 he joined Cabot Corp. and served in various



management positions before becoming financial VP and director in 1969. He then joined State Street Bank in 1975, serving as president and CEO, president and chair, and chair before becoming chair emeritus in 1992.

LAWRENCE A. HOUGH, SM '72. Born in 1944 in Janesville, Wis., Hough received an SB in engineering from Stanford in 1966 and the SM in management from MIT's Sloan School of Management in 1972. He joined the Student Loan Marketing Association (Sallie Mae) in 1973,



and except for an 18-month period in 1977-78 when he was CFO of the Hough Manufacturing Co. in Janesville, he has been with Sallie Mae ever since. In 1990 he became president and CEO. Hough was twice world champion and a silver medalist in the 1968 Olympics in rowing and he served on the board of the U.S. Olympic Committee from 1976 to 1984.

BRIAN G. R. HUGHES, '77, was born in 1954 in Toronto, Ontario. He received the SB in mechanical engineering from MIT in 1977 and an MBA from the Harvard Business School in 1979. Hughes was co-founder and executive VP of PTAT System Inc., which was established to develop a privately funded transatlantic fiber-optic telecommunications cable system. The completed PTAT system was sold to U.S. Sprint in 1989. Since then Hughes has been associated with the American Rocket Company, being named CEO in 1992.



DAVID H. KOCH, '62. Born in 1940 in Wichita, Kans., Koch received both the SB and SM degrees in chemical engineering from MIT, in 1962 and 1963 respectively. Koch worked as a re-search and process engineer for Amicon Corp., Arthur D. Little, and Halcon International, Inc. He joined Koch Industries, Inc., in 1970, serving in a variety of positions with Koch Engineering Company and Koch Membrane Systems. He is currently a

director of Koch Industries and executive VP for chemical technology.

JOHN A. MOREFIELD, JR., '56. Morefield



was born in 1934 in Philadelphia, Pa. He received the SB in business and engineering administration from MIT in 1956. He then joined Morefield Communications, Inc., a family-owned firm

based in central Pennsylvania that provides business communications systems—voice, data, video, and audio. He became president in 1964 and has been semi-retired since 1991, dividing his time between the company and community service.

ROBERT A. MUH, '59. Born in 1938 in New York City, Muh received the SB in management from MIT in 1959 and also holds MBA and MPhil degrees from Columbia University, received in 1961 and 1965. He



began his business career at McKinsey & Co., in New York and subsequently served as chair of Newburger, Loeb & Co., Inc., and as president of Financial Services International. In 1978 he joined Bear, Stearns & Co., Inc., serving as managing director in charge of the San Francisco region of the company from 1984 until 1987. Since then he has been an independent investment banker.

KENICHI OHMAE, PhD '70. Born in Japan in 1943, Ohmae received the SB from Waseda University, the SM from the Tokyo Institute of Technology, and the PhD in nuclear engineering from MIT. Ohmae worked for Hitachi as a senior



design engineer on Japan's prototype fast breeder reactor, the Monju. He is now a director of McKinsey & Company, Inc., in Tokyo. A prolific writer, Ohmae is the author of numerous articles on the economy and politics for such major publications as *The Wall Street Journal* and *Harvard Business Review* and has published 36 books. These include *The Mind of the Strategist: The Art of Japanese Business*, *Triad Power*, *Beyond National Borders*, and *The Borderless World*.

THE NOMINEE FROM RECENT CLASSES

DARCY D. PRATHER, '91. Born in 1969 in St. Louis, Mo., Prather received two SB degrees from MIT in 1991, in electrical engineering and in science, technology, and society. Since 1991 he has been studying philosophy, politics, and economics at Oxford University as a Rhodes Scholar.



Prather's remarkable record while at MIT included being named a National Football Foundation and College Hall of Fame Scholar Athlete in 1990. He was active in the National Society of Black Engineers and served as its president in 1989-90.

FILLING AN UNEXPIRED FOUR-YEAR TERM

ALAN B. DAVIDSON, '89, was born in Baltimore, Md., in 1967. He received the SB in mathematics with computer science from MIT in 1989 and the SM in technology and policy this spring. He worked as a senior consultant at Booz



Allen & Hamilton Inc., in Bethesda, Md., in 1989-90, and in the summer

and fall of 1991 he was an intern and consultant in Con-gress's Office of Technology Assessment. He is now a student at Yale Law School.

SERVING AS AN EX OFFICIO MEMBER

RICHARD A. JACOBS, '56. Jacobs was born in 1934 in Portland, Me. He received the SB in industrial management from MIT in 1956 and an MBA from Roosevelt University in 1979. Since 1992, Jacobs has been president of his own consulting firm in Northbrook, Ill. He also serves as counsel/senior VP of A.T. Kearney, Inc., has been associated with Mobil Chemical and Champion International, and was a VP of Questor Corp. Jacobs joins the Corporation as an ex officio member as the president of the Association of Alumni and Alumnae of MIT for 1993-94.

The Corporation is comprised of 75 leaders in education, science, engineering, and industry. Of the 75, 24 are currently life members. In addition, 25 individuals are life members emeriti, participating in meetings but without a vote. The Corporation meets four times a year to consider broad policy issues and participates in the life of the Institute through a number of committees, notably the 26 Visiting Committees (which provide counsel to the academic departments).□

lar notion. For many alums, even the idea that MIT has an intercollegiate football team still takes some getting used to, although that milestone was passed in 1978.

For three years, Homecoming has been slowly picking up steam, and for months now, the Alumni/ae Association, Athletic Department, Student Center Committee, and many of the living groups have been planning for this year's event. In addition to the football game, there will also be field hockey and men's and women's soccer games, sailing races, the league championships in men's cross country, and a rifle competition, all scheduled for Friday or Saturday.

Saturday will be the busiest day. There will be a carnival run by the Student Center Committee, and Phi Gamma Delta (Fiji) will sponsor a barbeque (living groups are being encouraged to sign up for tables). Following the football game, there will be a reception in the Athletic Center Lobby to honor MIT's scholar-athletes: all 60 winners of GTE Academic All-America honors and all 24 recipients of NCAA Post-Graduate Scholarships have been invited back. (For the last five years, MIT has produced more Academic All-America athletes than any other institution, reports Roger Crosley, MIT's director of sports infor-

mation. In 1992 MIT had the highest number of NCAA Post-Graduate Scholarships as well.)

Saturday evening, there will be dinners and house events at many fraternities and other living groups and an MIT Symphony concert. AMITA will hold a Sunday brunch for women graduates.

"There are a lot of alums out there who don't want to wait five years for an invitation to reunions," says Theresa Joyce, the Alumni Association Homecoming coordinator. "Many grads also like the idea of being on campus when the students are here. The atmosphere is very different in October than it is in June."

Alumni/ae who are thinking of returning for Homecoming are reminded that discounts are available at a number of area hotels, restaurants, and retailers for holders of an MIT Alumni/ae Association member card. Call (617)253-8265 to receive a complete listing of all current discounts. For Homecoming information, check with your former living group or call the Alumni/ae Association at (617)253-8280. If you arrive in Cambridge on Friday, check in at the Alumni/ae Association office, Room 10-110, for the up-to-the-minute schedule. On Saturday, information will be available at the Homecoming table in front of the Student Center.□

Homecoming . . . at MIT?

Brilliant leaves, brisk breezes, tailgate picnics, old friends and former housemates, sails on the Charles, the MIT Homecoming game. . . say that again?! Yes, indeed, the MIT Homecoming game—make that games—will be played Oct. 22-23.

For those who graduated from MIT before 1990, the idea of an MIT Homecoming weekend is probably an unfami-



Fixing What Ain't Broke

A record Technology Day luncheon gathering heard President Charles Vest respond to the critics of research universities. In his remarks, he told us about MIT's repeat recognition as the number-one engineering and science university in this year's ratings of graduate programs in a popular news magazine. He also noted that the Sloan School has improved its ranking among the top 10 schools of management.

On the previous day, in an effort to develop topics for discussions with alumni/ae over the coming year, I had met with Provost Mark Wrighton to talk about campus issues and needs. The provost made me aware of many changes in the education that MIT is providing to its students, but Vest's remarks were causing me to reconsider what Wrighton had to say.

The changes Wrighton laid out are hardly cosmetic. Rather, they are of the type that knocks socks off: a new five-year professional-degree program in electrical engineering and computer science, the introduction of a core requirement in biology, and a total renewal of the management curriculum, among other important differences. In fact, he reports that all of MIT's schools are introducing significant revisions to current curricula.

Less than 24 hours after that conversation, Chuck Vest was sharing his pride in MIT's leading position in the ratings, which suggested to me that the existing curricula are working just fine. I called the provost back. "Why," I asked, "are we fixing what ain't broke?"

Learning to ask *why*? is fundamental to an MIT education. It was impressed on us from our days as freshmen, every time we assembled in 10-250 for lectures in core subjects. And it is an approach I believe all of us retained and share as part of a common heritage. I should have known that the faculty share it as well. They wouldn't have participated in curriculum change unless they had questioned and been satisfied.

Distilling those faculty deliberations



in very broad strokes, Wrighton explained that MIT enjoys a reputation built on curriculum decisions made in the past. Constant review and updating are essential, however, if the Institute is to guarantee its leadership position in the future. Each of the deans and department heads, he assured me, could fill in the specifics of what future leadership would require, and therefore what was motivating curricular change in his or her field.

Like the proverbial light bulb switching on overhead, I found that I had a set of goals for my year as president of the Association of Alumni and Alumnae of MIT. In a nutshell, I want to continue the satisfying task of asking *why*, but I want to put myself in your shoes. I want to ask *your* questions about why things are happening at the Institute and in the Alumni/ae Association.

I'll need your help—you'll have to communicate your concerns to me. It's not hard: you may give me a call at my home/office in the Chicago area, (708)446-1390. If you don't catch me at my desk, my answering machine is running. Are you equipped with a computer and modem? Send electronic mail to me through the Association, mitALUM@mitVMC.mit.edu; fill in my name as the "subject." Or drop me a line in care of the MIT Alumni/ae Association, 77 Massachusetts Ave., Cambridge, MA 02139. I can direct your questions to the people who should know.

I don't expect the membership to initiate all the communication. I have

already embarked on a plan of meeting with as many alumni and alumnae as possible at gatherings of MIT clubs, starting with the Club of Brazil in June. These encounters offer another chance for you to share your questions and for me to share—or find out—the MIT answers you are looking for.

There is a large question that your volunteer alumni/ae leadership is already addressing: namely, is the Association "broken?" We don't think so, but that doesn't mean it cannot work better. To this end, Robert Muh, '59, the immediate past president, launched, and I expect to complete, a review of the Association's mission, role, and strategies—including the by-laws.

Where is the Association going? Is it offering the services alumni/ae really want? Does it spend time and resources on dinosaur activities that are irrelevant to your current needs? If the services are the right ones, are they advertised effectively to those who might use them? As I write, we are preparing a questionnaire on these topics to be sent to a sample of alumni and alumnae, and we are counting on a response that will help us chart our future path. Graduates who do not receive the questionnaire are encouraged to relay their views by any medium that seems comfortable. All thoughts are helpful, all ideas are relevant.

As we move ahead, and as I receive questions of general interest, I will use the pages of *Technology Review* to keep you updated and informed. The January issue of the magazine, for example, will carry an article on the Alumni/ae Leadership Conference in October, which will focus on changes to curricula. Deans and department heads will join the president and the provost in explaining the changes and answering questions for our most active volunteers, and their exchange will be reported in the *Review*.

Best wishes,

Richard A. Jacobs

Richard A. Jacobs, '56, President, Association of Alumni and Alumnae of MIT



Reunion is an occasion of many moods, but the one that comes through best in the photos is festivity. Clockwise from top left: the Classes of '78, '83, and '88 party at the World Trade Center; Technology Day speaker Lissa Martinez, '76, having some fun at the Ocean Engineering Centennial dinner at the New England Aquarium; members of the Class of '73 paper airplane team preparing their entries under the watchful eye of judge Frank Cheng, '67 (standing, center); and members of the Class of '68 indulging in some "hexagonal close packing," another event in the Alumni/ae Challenge Games.

THE MANY MOODS OF REUNIONS

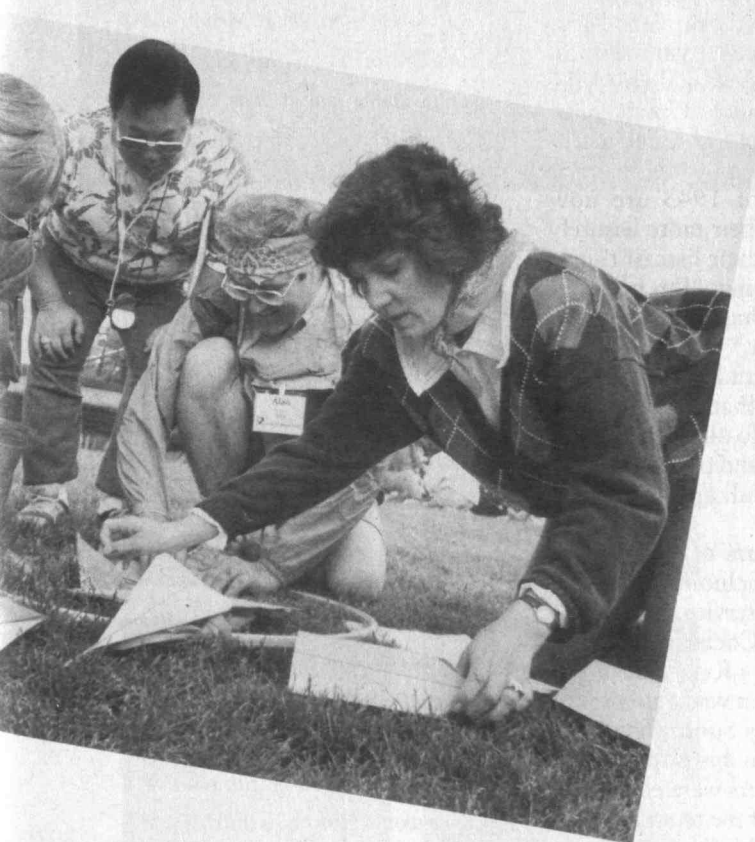
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The magic of a class reunion is the complex of emotions it evokes. At few other human events are so many moods compressed into so few hours: joy in renewed friendships and memories, pride in achievement and in the institution that fostered it, nostalgia for a past that can never be recreated, trepidation—even fear—in meeting people once intimates who are now strangers, and (for older classes) painful awareness of how fleeting is the fellowship that makes a reunion special.

For most of the 2,800 reunion visitors to MIT last June 3, 4, and 5, pride was the first emotion, beginning with an extraordinarily spirited chorus of “In Praise of MIT” that moved Boston Pops conductor Ronald Feldman to lead the orchestra in applause for its audience at Tech Night at the Pops.

Abetted by June weather as fine as Boston can offer, the spirit of praise never faltered until the last hug and the last handshake during Sunday morning departures. It peaked at the Technology Day luncheon on June 4, as the 14 reunion classes from 1923 to 1988 and the Class of 1993 announced gifts to MIT that together came to just under \$37 million. A significant fraction of the total was specified for scholarships and professorships.

“A spectacular, heartwarming moment,” said President Charles M. Vest after the presentations. “These gifts



represent not money but love, gratitude, and faith in our future, a recommitment to our students of today and tomorrow."

Pride in MIT was fostered, too, by the highly successful Technology Day presentations celebrating the 100th anniversary of the Institute's programs in naval architecture and marine engineering—a tradition now continued by the Department of Ocean Engineering. And by the inventive competitions of the annual Alumni/ae Challenge Games: paper airplane contest, sack race, "tuition riot," design competition, even an alumni/ae bowl with problems devised by the Institute's renowned cosmologist, Professor Alan Guth, '68. (The intrepid contestants answered them all.) Here's a sample: "suppose that there were a planet that is twice as far from the sun as the earth is. How many earth years would it take for this planet to make one revolution around the sun?" (Answer: 2.8 years.)

The apprehension that a reunion can trigger were well expressed by Gail Marcus, '68, anticipating her 25th reunion: "What will everyone be like? Will they look the same to me? More anguishing, will I look the same to them? Will it be bittersweet to see each other looking older and to find our dreams have changed, or will the years be irrelevant?" Marcus's thoughts and emotions were shared with her classmates in their reunion book, a memento that has become very popular, particularly among classes returning after 25 and 50 years.

Just over 200 members of the Class of 1943, for example, responded to the class survey conducted by its president, James O. McDonough, and the results were a special feature of their book. Among their discoveries: 160 respondents said they would choose MIT again if they had to do it all over; 173 would encourage one of their children to come. Needless to say, much of that loyalty stemmed from MIT's role in its graduates' interesting and productive careers. Summarizing a professional

engineering life that included work on supersonic fighters and the *Gemini*, *Apollo*, and *Voyager* space missions, Kemp Maples wrote, "Fifty-four years ago I could not have visualized a career path that would be more challenging and satisfying than the one that unfolded as a result of my MIT experience."

Paul Colsmann said that MIT's "teaching me how to think logically" was the most distinctive feature of his education. Over the years David Falk has concluded that MIT's most important lesson for him was "the requirement to state the problem before trying to solve it." Several, like E. John Pennington, wrote of the way their MIT experiences were enriched by their fraternities. And a few could see room for improvement: "Human relations and personnel management courses were missing," wrote Dexter Bowers. Morton Goodfriend voiced a variation on that theme, saying he wished that MIT had fostered "the ability to interchange with all types of people" through teaching psychology.

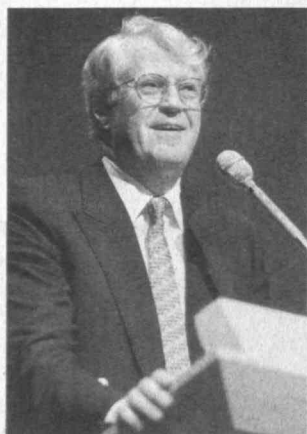
Most members of 1943 are now retired. They relish their more leisurely lives, but find that their lists of things to do just keep growing. "I'm behind than ever in the things I want to get done after retirement," quipped Robert Nelson. But retirement has its poignant side, too: "Why is it that when we have time and money to do all the things we have been dreaming and planning to do, our bodies seem to fall apart?" mused Ira Cruckshank, '43.

Some 200 members of the 50-year class are deceased, including a number who died in military service. Among the latter is William J. Cochran, killed in 1958 in the crash of a K-135 Air Force strato tanker. Cochran wrote to his parents from MIT every Sunday evening, and the letters from his sophomore, junior, and senior years were edited and published in honor of the reunion by his cousin, Robert B. McKersie, deputy dean of the Sloan School. The book, *Studying, Playing, Working, Dancing*,



Alumni/ae at reunions are nothing if not flexible, moving from one activity to another with barely time to change clothes. Clockwise from above: Members of the class of '53 took full advantage of the dance floor at their Walker Memorial dinner dance. In spite of the intense effort of the Class of '63 (pictured) in the 2.70 design competition, the Class of '83 won the overall title at the Alumni/ae Challenge Games. Corporation Chair and former president Paul Gray, '54, with a member of the Class of '53. (L. to r.) Norman Leventhal, '38, with Rebecca Vest, President Charles Vest, and Provost Mark Wrighton. A quartet of successful reunion gift chairs (clockwise from top left): Steve Finn, '68; Stan Proctor, '43; Royal Sterling, '23 (who remembers wondering at his 5th reunion if he would ever make it to his 50th, let alone his 70th!); and Richard Simmons, '53.





It was widely agreed that a highlight of Technology Day was a rousing presentation by Bill Koch, '62 (far left) on the success of his America³ boat in winning the America's Cup. Jorge Rodriguez, '60, was among the grads who got a glimpse of the cup when it was displayed on campus. But at the end of the day, the substance of reunion was, as always, the encounters of old friends, like Harold Tseklenis (left above) and Louis Eyster, both members of the class of '53, at the reception at President Vest's house.

Marching & Hacking at MIT in the Early 40s, is hard to beat for evoking nostalgia: Field Day, the Assemblies Ball, corsages for \$1 and sports-shirt-and-pants combinations for \$5, Arthur Murray dance lessons, track coach Oscar Hedlund, Scollay Square, the attack on Pearl Harbor . . .

Excerpts from Gail Marcus's essay in the Class of 1968 reunion book show how different it is for the 25-year class. "We're basically a predictable lot," she

writes matter-of-factly. "Our mean income is high. We like upscale, high-tech toys. At 40-something our health is generally good, though we have gained weight and lost hair. For all of us the exuberant image of being boomers and yuppies has given way to the more burdened image of the sandwich generation."

But for all, MIT's magnet is strong. After only 25 years Marcus captures that powerful attraction. "Even far from

Cambridge," she writes, "the school reaches out and ensnares us.

"Though I came here to study math and physics, it is the other things I learned that have meant most to me—to care, to think, to dream. To aim high, to work hard, to play just as hard. To be different. To challenge my limits. We all left with a way of thinking, an approach to life, a set of standards that identifies us, friendships that link us firmly to this place. . . . I have a love

affair with the Great Dome, Calder, Nevelson, Cambridge, Boston. I look for mentions of MIT in *Science* and in the newspapers. I see every [Professor of Literature] A. R. Gurney play. I take perverse pride in MIT's high tuition. I still know most of the course numbers. I still call it the 'Tute.' "

The major reunion gifts announced at the Technology Day luncheon were totals of giving to MIT by class members during the five years ending with the reunions and pledges payable during the subsequent five years:

■ From the Class of 1968 came \$1.7 million from 65 percent of the class. Steven Finn, gift chair, said that he and his peers have begun to recognize "the extraordinary role MIT has played in our lives."

■ "MIT gets a significant amount of credit for what we have accomplished," explained Richard Simmons, gift chair for the Class of 1953, in announcing a record 40th-reunion total of \$6,634,882.

■ When the 50-year class of 1943 arrived for the start of its reunion in Scarborough, Maine, on May 31, it was somewhat short of its \$4-million goal. But pride—and perhaps some last-minute arm-twisting—did their work, and Stanley Proctor, gift chair, announced a total of \$4.025 million on June 4.

■ Another record-breaker: Royal Sterling, class president, reported gifts and bequests from the Class of 1923 totalling \$16.3 million. Ten classmates were with him, and they received a standing ovation; the class's reunion gifts in 1973 and 1988 had also set new records.

Five-year giving totals were announced for the Class of 1933: \$3,334,222; and for the Class of 1928: \$2,720,764.

The other reunion gifts, counting contributions received only since July 1, 1992, and reported at the luncheon by alumni/ae president Robert A. Muh, '59, are shown in the next column. □

—John I. Mattill

The following reunion gifts represented contributions by members of each class during the fiscal year starting July 1, 1992:

Class of 1938	\$239,865
Class of 1948	545,421
Class of 1958	184,794
Class of 1963	622,900
Class of 1973	136,265
Class of 1978	91,484
Class of 1983	36,102
Class of 1988	16,750

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IN A WORLD OF PROBLEMS, A SUCCESS STORY IS A HIT

By Lisa Watts

No one attending Technology Day was surprised to hear that of all the schemes launched by businessman William Koch, '62, his favorite was entering—and winning—the 1992 America's Cup. A relative newcomer to sailing, Koch claimed yacht racing's most tradition-steeped trophy in maverick style, using a radical boat design and rigorous training regimens. And he beat the odds by pulling together his *America's* team and boats in a little under two years, less than half the time his competitors devoted to their entries.

Koch was the clean-up hitter for T-Day's morning program in June. In a world plagued with seemingly intractable problems and a scientific climate dominated by unanswered questions, Koch's tale of triumph was a welcome change of pace for the alumni/ae

who packed Kresge Auditorium. His presentation—including two videotapes of America's Cup action—was laced with themes of patriotism, teamwork, and victory. And his final message, that "ordinary citizens taking a scientific approach and working as a team can accomplish extraordinary things," brought the audience to its feet, applauding enthusiastically.

Koch's success may have been in a narrow arena, but his listeners found his message to have broad applications. During an afternoon session on the post-cold War mission of the Navy and its related industries, for example, panelists and alumni/ae in the audience pointed to the steady shrinking of defense dollars for research and development and the decline in commercial shipbuilding and other maritime endeavors in the United States. One alumnus, calling for a revision of regulations that he says are strangling the domestic shipbuilding industry, drew inspiration from Koch's comments on competitiveness.

A Commitment to Teamwork

Alumni/ae have still more reason to feel good about Koch's success. Jerry Milgram, '61, Koch Professor of Ocean Engineering, led the *America's* design team, which included a number of MIT naval architects and technologists. Koch reported that his reliance on extensive tank-testing of boat hulls and experiments with new materials made his syndicate the butt of jokes from seat-of-the-pants competitors, who called his team "the one headed by a nerd from MIT."

The high-tech approach did not come cheap: the total price-tag for *America's* was \$68 million. Asked time after time how he feels about spending so much on a sailboat race, Koch says, "It's outrageous, it's obscene, it's incredible. But was it worth it? Absolutely—we won."

One member of the Class of '52 seemed to speak for his fellow T-Day attendees when he told Koch during the morning question period, "I must admit

to feeling some pride as I watched the course of your program." Said an alumna, "It was wonderful. Why don't you do it again, or why don't you run for president?" One of Koch's fellow panelists, Sylvia Earle, founder and director of Deep Ocean Engineering, Inc., remarked that she'd like to see Koch go into designing submersibles as his next project. (Submersibles already employ some very sophisticated technology: Earle told of a recent Antarctic expedition in which an unpiloted craft went deep below the pack ice while being controlled, via satellite, from her laboratory in San Francisco.)

Rounding out the morning program were Carl Wunsch, '62, Green Professor of Physical Oceanography at MIT, and Robert Spindel, director of the applied physics laboratory at the University of Washington. Spindel described the latest methods of measuring ocean temperatures, salinity, and circulation, methods which are made possible by remote satellite and computer technology. Present techniques are a huge improvement, he noted, over the cold, wet, seasick days of ship-based sampling. Wunsch, who is an originator of the World Ocean Circulation Experiment, said that political and scientific discourse on global warming has been too narrowly focused on whether or not warming is occurring. Because ocean circulation patterns—and thus climate—have varied widely over the centuries, "we *will* have climate change," he said. "Something that has been chaotic in the past doesn't suddenly become static. We need to move on to the broader question of what are we going to do to ameliorate climate change."

Koch closed the T-Day morning session by presenting a half-sized replica of the America's Cup to Paul Gray, '54, chair of the Corporation. Pointing to lessons he first learned from his MIT basketball coach, Jack Barry, Koch asked that the trophy be awarded annually to a student who best represents a commitment to teamwork.

Rallying Defense Resources

During an afternoon session on new naval missions, John Deutch, '61, Institute Professor and MIT's former provost, offered a perspective on military downsizing from his new post as undersecretary for acquisitions and technologies in the Department of Defense. He predicted that funding throughout the various forces will "decline rapidly" to less than 3 percent, which is in line with peacetime budgets since World War II.

In light of the reduced spending, Deutch said, President Clinton's primary concern after ensuring the war-readiness of U.S. forces is "how we can use the resources of the Defense Department to improve our economic performance." The secretary cited technology training and information management as examples of military expertise that could be applied to national needs, such as breaking up the paperwork logjam in the U.S. health care system.

Faculty and guest speakers at other T-Day afternoon sessions discussed innovations in boat design, from Olympic racing shells to tourist submarines, new technologies in ocean exploration, and oil spill issues. (See *related article below*.) □

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SHIPS DON'T SPILL, PEOPLE DO

Today's marine oil spills are overwhelmingly the consequence not of faulty engineering but of politically motivated policymaking and penny-wise, pound-foolish economics. Virtually every aspect of United States marine policy affecting tanker design and operation is a tangle of contradictions, said speakers at a lively and well-





Above: women of '68 (from left) Shirley Jackson, Aviva Brecher, and Susan Downs. Left: Harold and Anna Tseklenis at the Class of '53 dinner dance. MIT faculty member Alan Guth, '68, with classmates.

attended Technology Day afternoon session on oil spill issues.

"We have got to where we are," said Admiral J. William Kime, SM '64, commandant of the United States Coast Guard, "by the reluctance of responsible people to take responsibility." Kime was one of four speakers helping the Department of Ocean Engineering mark the centennial of the establishment of its forerunner, the Department of Naval Architecture.

Overproduction by the world oil industry and the unwillingness of many consumers (especially those in the United States) to pay realistic prices for fuel have put severe financial pressure on shipowners—now chiefly banks and syndicates—say Kime and other industry-watchers. Maintenance is deferred, crews are overextended and inadequately trained, and ships are registered in small countries that have no marine infrastructure.

"Ships are falling through the safety net," said Admiral Kime.

In its frustration, the U.S. Congress in 1990 passed an Oil Pollution Act that was intended to put new safeguards in place. New vessels planned for trade with the United States would be required to meet stricter safety requirements. All owners of vessels trading with the United States were assigned unlimited liability for environmental damage caused by their carriers, no matter where the fault lay, which constitutes a significant extension of the terms of the certificates of financial responsibility long required of shipowners before their carriers may enter U.S. ports.

But many of the promises that looked so good on paper have turned out to be empty. Insurance to cover the risks of unlimited liability is simply unavailable—no insurer will write it. (The Exxon Valdez accident in 1989 has cost the Exxon Corp. more than \$2 billion.) Since insurance is unavailable, so too are the revised certificates of financial responsibility. But the U.S. still demands cheap oil, so to resolve this dilemma, the Coast Guard has simply delayed imple-

menting the full provisions of the law. As a result, ships with inadequate insurance continue to operate here. "The United States is in effect inviting shipowners to play Russian roulette," said panelist Epaminondas G.E. Embiricos, '64, chairman of Embiricos Shipbrokers, Ltd., London.

Marine engineers and policymakers are disturbed by other aspects of the 1990 legislation. Embiricos even questioned one of its least controversial requirements: that tankers be built with "double bottoms"—tanks to contain oil that are separate from the hull structure. Three of the panelists said that such designs would significantly reduce oil spills. But Embiricos believes that if both hull and tank are pierced in an extremely violent grounding, oil can be exposed to air between hull and tank, a scenario that sets the stage for an explosion and catastrophic leakage.

The panelists were of one mind, how-

ever, that the 1990 act sets a disastrous regulatory precedent. Members of Congress and their staffs lack the technical expertise to make the rules in a field such as marine engineering, said MIT Professor Henry S. Marcus, '67. Admiral Kime's solution is straightforward: "We must do more research ourselves," he said, "if we want to discourage Congress from acting on its own."

Richard J. Quegan, general manager of Texaco's Marine Department, emphasized human factors behind accidents at sea. He is disturbed that threats of foreign competition and unlimited liability are discouraging capable Americans from careers in the merchant marine. "At a time when we should be encouraging our best young people," he said, "we are sending a message to stay away."

There is "a significant loss of skill" among masters and pilots, agrees Lissa Martinez, '76, SM '80, one of the nation's only independent consultants on marine

policy and management. "Bridge team management"—what happens on the ship's bridge—is an important, neglected topic. If the electronics breaks, does anyone know what to do?"

Martinez said that her exclusive professional status is just another symptom of an industry in trouble. She'd welcome company—even competition—from other marine consultants, because it would signify new life in shipping.

To all this bad news there is one silver lining: the vast quantity of the oil and oil products now being shipped offers an unprecedented opportunity as well as great risk. The volume carried in tankers is so high, said Copenhagen shipbuilder Cato Svedrup from the audience, that significant economies of scale are created. For example, he maintained, renewing the entire global tanker fleet in the next decade would add only \$1 per barrel to the price of oil. □

—John I. Mattill

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ARTS PARTISANS DEBATE WHAT COMES NEXT AT THE NEA

The creative arts represent our common heritage and the universal need for positive expression," said Senator Edward M. Kennedy when he opened a national conference on federal funding for the arts held at MIT in June. "Sometimes art shocks our sensibilities. . . . But that is no justification for unwarranted intrusion by extremists who, if the truth be known, oppose any federal aid to the arts."

With those words, Kennedy anticipated the consensus that would emerge early in the two-day conference: After a decade of attempts—often successful—to restrict federal funding for "controversial" art, the National Endowment for the Arts should operate free of political interference.

The gathering, entitled "The Public Patron: Drafting a Mandate for a Federal Arts Agency," was planned to help lay the groundwork for upcoming Congressional hearings on the reauthorization of the NEA. It was also the hope of the meeting's sponsor, MIT's Office of the Arts, that the discussion would inform the arts-funding policies of the Clinton administration. About 200 people came from across the country to engage with panels of artists, policy makers, scholars, writers, and arts administrators focused on issues such as freedom of expression and the role of artists in democratic society.

"I believe that there is a fundamental principle," said MIT President Charles Vest in his remarks, "that the free investigation of ideas, coupled with merit review by knowledgeable experts, is essential for maintaining the intellectual and artistic quality and integrity of work sponsored by [federal agencies]." The seriousness of Vest's commitment to these standards is underscored by the fact that MIT's support of peer review in the arts closely parallels its position on federal sponsorship of research in engineering and science. And the assembly was well aware that among the most controversial of the NEA-funding decisions made under the Reagan and Bush administrations was



**CRITIC ROBERT
HUGHES BELIEVES THAT
THE POLITICALLY CORRECT
POSE AS MUCH
OF A THREAT TO ART AS DO
THE CONSERVATIVES.**

the withholding of support for the exhibit, "Corporal Politics," at MIT's List Visual Arts Center in 1992.

Several speakers noted that supporting controversial and even offensive art is, in fact, an unavoidable part of the NEA's responsibility. Good art, after all, is not always popular in its time. "I remind myself that *Moby Dick* ruined Melville's career as a popular author, and Cary Grant never won an Oscar," said sculptor Judith Shea.

Katy Kline, director of the List Center, noted that Manet's "Dejeuner sur l'Herbe," was perceived in the France of 1863 as a "scandalous outrage and offence." The artistic sensibilities that Manet offended are seen today as "laughable, grandiloquent pomposities," she said. "I'd like to think of government [arts] patronage as research

support," Kline continued, "a subsidy of the inventive and independent thinking of creative investigators. This of course involves a certain amount of risk."

Where panelists expressed sharply divergent views, however, was around questions of "multiculturalism" and the possibility of fairly assessing artistic quality outside of a cultural context.

Keynote speaker Robert Hughes, an author and art critic for *Time* magazine, derided conservative Senator Jesse Helms and other public figures who have opposed funding of controversial art. But Hughes reserved his sharpest criticisms for a very different constituency, "those hypocritical pests of academe: the politically correct."

"In an overpopulated art world with a depressed market, you are going to hear more and more about discrimination against artists—endless complaints about racism, sexism, and so on," said Hughes. "Quality, the argument goes. . . is the result of a conspiracy to marginalize the work of other races, other cultures."

Hughes contended that preferential selection for women and minority artists had indeed been operative at the NEA in recent years, and he worries that "this sentimental form of cultural diversity" could become more influential under a Democratic Clinton administration. The result, Hughes warned, would be the funding of "mediocre" art. "The NEA has to be prepared to resist unreasonable pressure, not only from the moralists and censors of the fundamentalist Right. . . but also from the censorious Left, with [its] consistent portrayal of the liberal ideal that high cultural standards can be popularly accepted and practiced."

While Hughes fielded only polite questions after his talk, his arguments were vigorously challenged the next day by several panelists and audience members. "I admire his forthright approach, his candor," said Adolfo Nodal, head of the Department of Cultural Affairs of Los

MIT'S VIGOROUS DEFENSE

OF PEER REVIEW AS THE STANDARD FOR PUBLIC FUNDING APPLIES

TO THE ARTS AS WELL AS TO RESEARCH.

Angeles, "[but] his smugness and naïveté about the issues of representation and ownership in the cultural process, by communities who have been systematically denied access, can only be described as quaint." Nodal urged a broader understanding of art as a "tool for achieving peace and harmony in our ravaged neighborhoods," where groups from very different backgrounds have to coexist.

"To make excellence the ultimate guide," he said, would "ghettoize the arts into some kind of an elite club." Nodal said that evaluating art by standards of quality alone would leave no place for people like "the brothers that I know in the South Bronx who have for years been scratching and clawing to make do with nothing, to perfect their theater. . . so they can uplift their kids and their families and their neighborhoods." Visually talented children of East Los Angeles are forced to channel their creative drives into graffiti

because there are no cultural programs for them, Nodal went on.

Texas Art Commission director John Paul Batiste echoed Nodal's views, pointing to a long history in which the art world has been ruled by "one dominant agenda, one dominant perspective on culture and intelligence, and one race."

Like most issues raised in this diverse assembly of arts partisans, the question of cultural access and equity for minority groups was roundly debated but not resolved. But by the end of the session, the conference organizers were satisfied that their goal of provoking a broad, inclusive public dialogue on arts funding had been achieved.

"We've received a number of comments that it was a substantive conference, that positions were put forward that reflect years of hard thinking about the vexing questions over the federal government's role in funding the arts,"

said Mark Palmgren, director of the Council for the Arts at MIT and conference organizer.

He added that the conference drew attention in Washington. The event was the subject of a balanced article in the *Washington Post*, Palmgren said, and members of Congress have been on the phone, requesting transcripts and more information.

One thing all speakers and participants seemed to agree on was that "MIT is an ideal venue for this conference," as Senator Kennedy put it. "This incomparable institution has produced some of the finest scientists and thinkers of our time. And it's no coincidence that MIT also has a long-standing policy that encourages training in the arts as a means to foster creative thinking and well-rounded human development." □

—JIM HIGHT (The author is a freelance writer and the coordinator of United Youth of Boston, a multi-ethnic, city-wide newspaper by and for teenagers.)

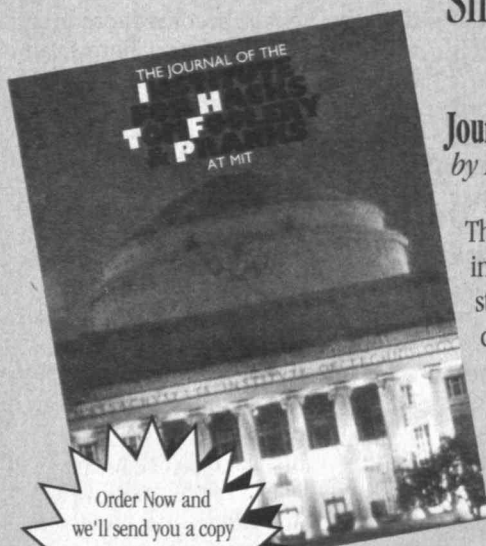
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CLASS NOTES

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We have received an obituary reporting the death of **Herbert W. Hatch**, 98, of Auburn, Maine, on May 12, 1993. Mr. Hatch was an architect with the firm of J. Williams Beal Inc. in Boston. He had been a long-time resident of Wollaston, Mass., where he had been a trustee of the First Baptist Church. He also was past master of Theodore Roosevelt Masonic Lodge where he was secretary for many years and was given life membership in 1945. He is survived by his wife, Ermie, a son, daughter, and four grandchildren.—*ed.*

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75th Reunion

Our Class President **Don Way** passed away on July 1. A memorial service will be held on July 10 that I plan to attend. I will report more next issue.

I find myself busier in my 99th year than most any other period in my life. Whatever thoughts I gave the matter in the past I had

thought it to be a time of rest and reflection. Not so. With doctors, lawyers, investors, handyman helpers, roofers, and much more, I find the days too short to cover the problems that confront us at this age and these to be more than I can do justice to. And then arrives the receipt of an envelope from Cambridge, Mass., marked on its face "Important Notice of Deadline Inside." So here goes!

As to our class, I'm sure they are all as busy as I am taking care of their old age affairs.

I have been busy lately on the question of our 75th Reunion next year. It would be a pity to miss it, when we might recall and share with a fellow classmate our memories of class happenings. For instance, I ran the quarter mile in what I recall was an interclass contest. I ran behind **Rod Bent**. The track was wet and I got pelted continuously by cinders from the track in my mouth and eyes. But our class won the quarter mile that year and it's still worth remembering.

So give our 75th-year Reunion some thought and feel young enough to attend. If I'm living I'll be there too with my wife, Florence.—**Bill Langille**, secretary, Box 144, Gladstone, NJ 07934

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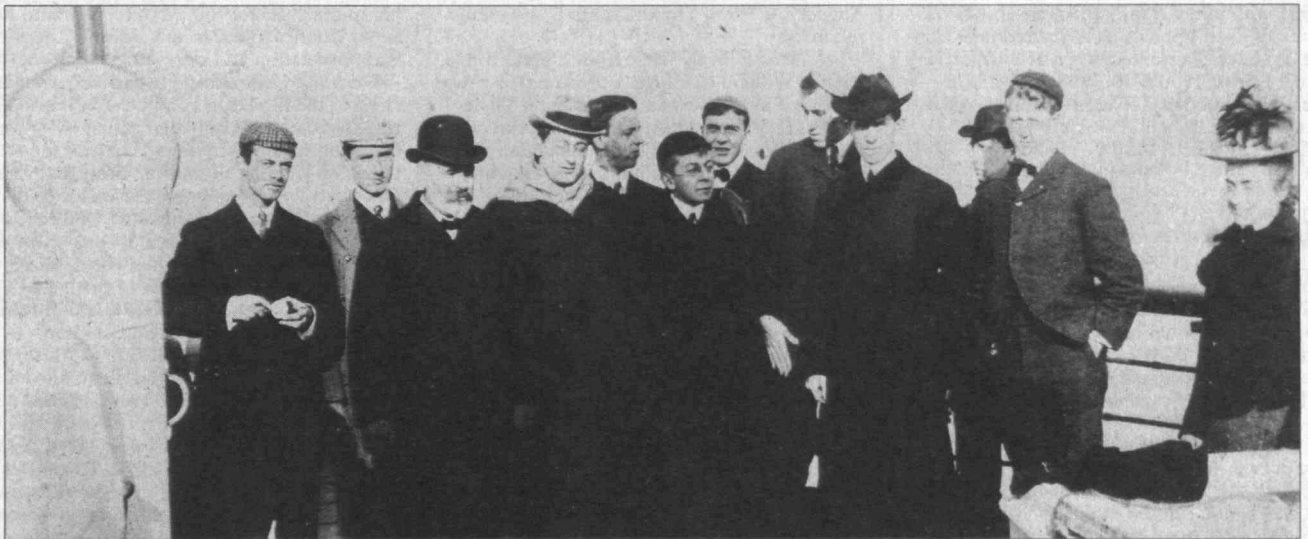
Please send news for this column to: **Harold Bugbee**, secretary, 313 Country Club Heights, Woburn, MA 01801

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Now that you have read the astounding literary report of "The MIT-James Joyce Connection" (*Technology Review*, April 1993), you know that our class has produced two more unusual alumni occupations to add to all those reported here over past years.

We refer to fields outside those that are known for making use of the solid scientific foundation on which MIT courses are based.

Vladimir Dixon, whose home was listed as Plainfield, N.J., in our senior *Technique* portfolio, was graduated with us in mechanical engineering. Born in Russia of an English engineer who had become a U.S. citizen and a Russian mother, Dick—as he was known to those of us in classes with him—was a brilliant stu-



*The centennial celebration of the Department of Ocean Engineering included mention that **Lydia Gould Weld**, '02, was the first woman to graduate from the department. This prompted **David Walton**, '48, to recollect that he "had the extraordinary chance to meet the lady" in Monterey, Calif., in the summer of 1954. It was in the midst of the "sardine depression," as he worked in one of his first jobs—assisting a tax accountant in an office where Weld was a client. "We didn't break out into a chorus of 'Tech on Boylston Street,' but she*

allowed a restrained comradery . . . she was very pleasant, very vital and very sharp." He learned that she had been one of the architects of the battleship Missouri. Walton asked her why she had chosen naval architecture. "When I was a little girl, I used to sit at the top of the ladder to the engine room of my uncle Jay's yacht, fascinated by the sights, sounds, and smells," she replied. "I never forgot them."

In the photo above, Lydia Gould Weld with her Course XIII classmates on a shipyard trip in 1901.

dent, pleasant and friendly, but very reserved.

He is responsible for adding those two uncommon occupations for a graduate engineer, namely that of traveling auditor for a manufacturer and, strangest of all, a poet of the caliber of James Joyce and Ezra Pound, with whom he corresponded.

Dick's father, a Singer Co. executive, had directed the construction of a Singer factory in Podolsk, outside Moscow, and became its manager. Dick joined Singer and trained at its Elizabethport, N.J., factory. He was assigned to the Paris office as the traveling auditor for installations throughout Europe, no doubt because he spoke four languages fluently and was good in a number of others.

His poetic ability is a complete surprise, although it may have been known to his Lambda Phi fraternity brothers at MIT. He wrote hundreds of poems; three books of them have been published, most in his native Russian.

Dick wrote to your secretary a couple of times before 1925 with little information other than that he had a good job and was not married. We now find out he married an American girl in 1925. They had one son, John, who was only 23 months old when his father died in Paris in 1929.

We have tried, unsuccessfully, to help John obtain more information on his father from Dick's fraternity brothers but, at this late date, all are either deceased or have not given MIT good addresses.

The complete Dixon family story is fully as fascinating as the details of how the literati solved the mystery of whether there was a Vladimir Dixon.

When you send your secretary your news to help us maintain this column, we highly recommend that you remind us to explain how to obtain a copy of the special issue of the *James Joyce Quarterly*, which gives both stories along with photographs and translations of many of Dick's poems. It beats fiction!—Carole A. (Cac) Clarke, secretary, 608 Union Lane, Brielle, NJ 08730, (908) 528-8881; Samuel E. Lunden, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274, (213) 833-1480

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Good news from a classmate who is still "alive and kicking." William A. Tripp writes: "I continue to be reasonably active and healthy. Other than my daily routine, my prime activity is bridge in the local duplicate clubs."

Your secretary regrets to inform you of the passing of two classmates. Frank Riekers died on December 1, 1992. Mr. Riekers spent his last days in Jupiter, Fla. . . . I must also report the death of Valentine Friedrich, Jr. on April 18, 1992, in Gorham, Maine.

I received a letter announcing my inclusion in the Fifth Edition of *Two Thousand Notable American Women* to be published this year by The American Biographical Institute, Inc.

If you have any cheery news, send it on to your class secretary.—Martha Munzer, secretary, 4411 Tradewinds Ave. E., Lauderdale-By-the-Sea, FL 33308

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The 70th Reunion is now history. Those attending were William Allis, Harry Green, Harry Kalker and his son Phillip, Paul Moore and his sons David and Richard, Kay and Jay

Stratton, Walter Webster and wife Florence, and Mary and Royal Sterling.

Only five of the grads attended Tech Day lunch. After all the gifts had been announced from the podium (the largest being around \$6 million), the microphone was brought to our table. I gave a description of our first five-year reunion 65 years ago. I said I wondered then if I would live long enough to attend my 50th Reunion. When I announced our class gift of \$16,303,000, MIT President Charles Vest came down from the podium and shook my hand. Then 1,140 people applauded in a standing ovation.

The class of 1928 joined us at the Faculty Club for the banquet, making a total of about 50 people. We were greatly honored in having Vest and his wife, Becky, with us.

After the reunion Mary and I drove to New Hampshire to see a collection of Sandwich Glass. Upon our return to Rhode Island, our good friend Dr. Leland Jones and his wife, Barbara, had a reunion brunch for me and graduates of Brown and Harvard.

In the last issue of the *Review* I requested class dues from all classmates. The only check I received was from Paul Moore's son Richard, who gave \$100 for our treasury.

Unless you send me news, this column will be very short or not at all.—Royal Sterling, president, 2350 Indian Creek Blvd. W., #D-201, Vero Beach, FL 32966-5103

24 70th Reunion

This is a sad column to write as I have six obituaries to report. One alumnus died in 1988. The Alumni/ae Association in Cambridge discovered that John J. McFarlin of 616 Whitby Dr., Wilmington, Del., passed away August 15, 1988. There seem to be no known relatives.

I received a lovely letter from Elinore Ridge, wife of William C. Ridge. Unfortunately it was to tell me of her husband's passing. William died May 30 in the hospital after an extended illness. Elinore writes that "Bill had had a long period of gradually declining interest in life, then quietly passed away without pain or struggle with arrested heart failure." Bill was born September 28, 1902, in Pittsburgh, Pa. He was a retired director of operations for the eastern division of the J.R. Roebling Co. of Trenton, N.J., a division of Colorado Iron & Steel. He graduated with a degree in mechanical engineering and was a member of Sigma Nu fraternity. Elinore remembers meeting, "the handsome blonde 'Rock' Hereford at Sigma Nu parties of long ago." Aside from Elinore, Bill is survived by a son, George Edward Ridge, and two grandchildren. Elinore says that they were happy together for 66 years. I can't think of a better tribute than that. The most sympathy to all the family.

A telephone call from Bill Gordon, son of Carlton C. Gordon, informed the Alumni/ae Association of his father's death on January 29. Our sympathies go out to all the family. . . . Also, Miguel Amezcaga, from Bethesda, Md., passed away April 5. This was learned from his daughter, Julia Amezcaga Stetson. Condolences to all.

A news clipping to the Alumni/ae Association told of the passing of James B. MacLean, who had been working as chief electrical engineer for Burns & Roe in New Jersey. He retired in 1967 but continued as a consultant. James was born in New York City and was a member of the Kings County Masonic Lodge in Brooklyn. He graduated from Wesleyan

University and later received a master's degree from MIT. James moved to Wilbraham, Mass., 10 years ago and attended the Wilbraham United Church. His wife, the former Muriel Britton, died in 1983. He lived with his daughter, Mary Ellen MacLean. Sympathy is extended to his daughter and family.

A news clipping tells of the death of Anthony D. "Matty" Matarese. He died April 12 in Glover Hospital in Needham, Mass. His wife, Carolyn (DeFazio) Matarese, died in 1989. In 1924 Matty went with Charles H. Tenney and Co., then spent two years with the Fitchburg Gas and Electric Co. He joined the staff of the Brockton Gas Light Co. in 1927, beginning a steady rise to the presidency of the organization. In 1948 he was elected VP of the firm and a year later was elected to the board of directors and made general manager. The Taunton Gas Light Co. merged with the Brockton Gas Light Co. in 1962, creating the Brockton-Taunton Gas Co., one of the largest in the area. He was elected president of the firm in 1955.

Among his civic duties, Matty had served as president of the Brockton Region Chamber of Commerce, a member of the board of directors of the Massachusetts Safety Council, chair of the Development and Industrial Commission, and a member of the board of investment of the Brockton Savings Bank. In 1958 he received the Treasury Medallion for his work as chair of the Brockton "Share in America" bond drive, and was named chair of the Greater Brockton Area Savings Bond Committee in 1965. In 1971 the White House appointed him chair of the National Alliance of Businessmen working in cooperation with government and labor to find jobs and job training for the chronically unemployed and underemployed.

Matty served two terms as a trustee of the Brockton Public Library, and was also a member of the executive board of the Squanto Boy Scout Council and a member of the American Gas Association and chair of its Domestic Advertising Committee. He had also acted as chair of the Brockton Family Service Association, director and campaign manager for the Brockton Community Fund, chair of the Brockton Chapter of the American Red Cross, and secretary, president, and director of the Brockton Commercial Club and University Club of Brockton. He was a 50-year member of Baalis-Sandford Lodge, A.F. & A.M. He was also a longtime member of the New England Gas Association and Gas Guild of Managers. He retired from the gas company in 1980 and moved from Brockton to Mashpee Island, Bourne, where he had maintained a residence for more than 40 years. He moved to the retirement community of North Hill in 1991. He was active for the past 18 years in SCORE (Service Club of Retired Executives) in Hyannis. He is survived by a daughter and granddaughter. Our sympathy goes out to all the family.—Co-secretaries: Katty Hereford, 237 Hacienda Carmel, Carmel, CA 93923; Col. I. Henry Stern, 2840 S. Ocean, #514, Palm Beach, FL 33480

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Class agents are not often mentioned except when they are involved in special reunion fund drives. Sam Spiker has served our class in this capacity for many years and has acknowledged in writing all your contributions to the Alumni/ae Fund. His efforts are much appreciated. Sam reported that last January, Reed Weedon, '41, asked him and Elinor to host an MIT after-

noon at Fox Hill Village in Westwood, Mass., their winter home. The meeting was held last April 8. Paul Gray, '54, and Priscilla were guests of honor and there were about 20 attendees—alumni, spouses, and widows.

With sorrow the passing of four classmates must be reported. . . . **John M. Campbell** died on May 11 at the St. Joseph Mercy Hospital in Pontiac, Mich. His home was in Birmingham, Mich. John joined General Motors following graduation. In 1947, he was named head of GM Research Fuels and Lubricants Department. In the late 1940s he began organizing GM research in the air-pollution field. In 1953, he helped form and became first chair of the Vehicle Combustion Products Committee of the Motor Vehicle Manufacturers Association. John was later appointed technical director of GM Research Laboratories and was named scientific director in 1957. He retired in 1968. John held patents on a number of processes and materials related to the efficient use of fuels. He was co-holder of a patent on an exhaust gas burner, a forerunner of the exhaust "afterburners" in everyday use now.

During his career he held numerous posts in professional, engineering, and scientific societies, including the Society of Automotive Engineers, the American Society for Testing and Materials, and the Engineering Society of Detroit. John was the author of more than 60 professional papers. In recognition of his long service, the GM Research Laboratories in 1980 established the John M. Campbell Award to be given annually to selected staff for outstanding contributions in the fields of pure and applied science. Surviving are his wife, Marie Kiswiney Campbell; two sons, John M., Jr., and Robert; three grandchildren, and a great granddaughter.

Franklin Fricker died March 20, in Naples, Fla. Frank had worked for the Portland Cement Association and in 1937 joined the Ethyl Corp. in Ferndale, Mich. He continued with Ethyl until his retirement. Frank's civic activities included chair of the United Way, Southeastern Mich.; president and board member of the Oakland (Mich.) County Legal Aid Society; board of trustees and VP of William Beaumont Hospital in Royal Oak, Mich.; board member of the Oakland County Mental Health Association; "Man of the Year," Ferndale Michigan Community Association; member of Village Players, Birmingham, Mich.; "Meals on Wheels" driver in Naples, Fla., and a 20-year volunteer in various departments of Naples Community Hospital. He was an active member of Trinity-By-The-Cove Episcopal Church in Naples and previously St. James in Birmingham, serving as an usher, a member of the vestry, and a warden. He was a member of the Moorings Country Club and the Collier Athletic Club of Naples. Frank is survived by his wife, Marion Van Wickle Mitchell Fricker; three sons, two daughters, two stepsons, twelve grandchildren, and five great-grandchildren.

Belatedly, the death of **Stephen J. Griffin** was reported as of February 1, 1991, in Hingham, Mass. . . . **George N. MacDaniel** of Borger, Tex., died November 28, 1991.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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Please send news for this column to: **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

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On May 8, **William B. Duffy** was honored and celebrated in his home town of North Andover, Mass. A new water treatment plant was dedicated with his name in recognition of his 41 years as superintendent of the Public Works. With a host of dignitaries, family, and friends, his wife, Gertrude (88), performed the dedication of the facility to him.

After a brief stint with the Mass. Department of Public Works, in 1930 he was named superintendent of Water Works in North Andover. It had a steam-driven pump that supplied drinking water to 7,000 people. When Bill retired in 1971, the water system had grown to supply 19,000 as well as the Western Electric plant on Route 125. The \$20 million water treatment plant is the latest improvement.

Bill Duffy is past president of the New England Water Works Assn. and past chairman and life member of the N.E. Chapter of the American Water Works Assn. In 1961 he received the George Warren Fuller Award from the AWWA.

We regret to report of his recent death on June 19, 1993.

Selim O. Lunden of West Hartford, Conn., died on July 16, 1992. We are sorry we have no information about his life in our files.

Edward E. Mott of Madison, N.J., died on March 28, 1993. After receiving an SM in electrical engineering, he joined Bell Telephone in Whippany, N.J. He worked there for 39 years as a specialist in acoustics. He developed acoustical instruments such as receivers for the telephone headset, and underwater devices for the Navy. He was granted 19 patents and is the author of several published technical articles.

Ed was a fellow of the Acoustical Society of America, a member of the Montclair Society of Engineers, and the MIT Club of New Jersey. He also belonged to the Senior Center, the YMCA of Madison, and Planned Parenthood of Montclair. In 1980, Ed made quite a sensation driving around town in an electric car, "the new gasless car of the future." It looked like an overgrown golf cart and he strongly recommended it for community travel.

Philip G. Rhoads of Wilmington, Del., died on May 10, 1993. He was one of our older classmates having previously received a degree from Haverford College in 1924. With a mechanical engineering degree in 1927, he joined J.E. Rhoads and Sons of Wilmington. This firm was founded as a tannery in 1702 and has continued for nine generations in the Rhoads family. The company now manufactures industrial conveyor belts and allied products. It is the oldest continuously run business in the United States.

After retirement, Phil became business manager and secretary of the Wilmington Public School System. He was responsible for computerizing the district business office.

Philip was a member of many charitable organizations including Council of Boy Scouts of America, Society of Natural History of Delaware, and Phi Beta Kappa Society of Delaware. He was former vice-president of Delaware Nature Education Society, past treasurer of Brandywine Valley Assn., former member of board of managers of the investment committee of Wilmington Savings Fund, former chair of manufacturing section of the Chamber of Commerce, and a past member of Advisory Board of Liberty Mutual Insurance Co.

With all this activity, a family member said, "He was an extraordinary, humble man." His life was a typical and excellent example of

MIT retirees contributing their time for the good of their community.

We offer our condolences to the wives and families of these fine classmates.—**Joseph C. Burley**, secretary, Isle of Springs, ME 04549; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

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The future appears a long ways off sometimes—and then suddenly it's in the past. So it is with our 65th Reunion in June, which is already a third of a year into the past as you read this. It was a well-attended and enjoyable gathering of 24 classmates together with 19 family and guests, many staying all four days and attending most events. Attending classmates and wives were **Henry Buntschuh**, **Maurice Beren**, **Ana** and **Mariano Contreras**, **Barbara** and **Robert Crawford**, **Bettie (Chester) Day**, **Helen** and **Gabriel Disario**, **Roland Earle**, **Newton Foster**, **Lawrence Glassman**, **Dorothy (Carney) Goldberg**, **Walter Hildick**, **Arthur Josephs**, **Alfred Knight**, **Ernest Knight**, **Henry Lamb**, **Margaret** and **George Mangurian**, **John Melcher**, **Beatrice** and **Harlan Paige**, **George Palo**, **Marjorie** and **Albert Puschin**, **Louise** and **John Reynders**, **Dorothy** and **Hermon Swartz**, **Miriam** and **Clifford Terry**, **Hyman Weinberg**, **James White**, and **Ruth** and **Abraham Woolf**.

The Alumni/ae Association staff and our reunion chair **Herm Swartz** did an exemplary job, providing coordination, transportation, and assistance from their reunion headquarters, for the classes of '28 and '33, at McCormick Hall. The weather cooperated with beautiful skies, except for one cloudy morning with a scattering of raindrops. The one somber note was that our class enrollment and attendance has become smaller and less active than in its prime, though it's still hearty. Let us maintain our class spirit through individual contact and our notes in the *Review*.

A reunion event for all classes was the memorial service in the MIT Chapel, at which **Frances (Mrs. James) Donovan** gave a reading. After the service, **Frances** and a representative of the Alumni/ae Association went to visit **Florence (Mrs. Walter) Smith** with flowers from the memorial service. **Florence** is making a slow recovery from her stroke last spring and would be very pleased to have cards and notes from classmates and friends. Her recovery and residence home is at Cogswell SE, Room 271, Carleton-Willard Village, 100 Old Billerica Rd., Bedford, MA 01730.

It is unfortunate that at this reunion time there are an unusually large number of deaths to report. . . . **John Gordon Collins** of Palm Beach, Fla., on March 9; **James Everett Cushing** of Arlington, Mass., on October 8, 1992; **George Stevens Hubbard** of San Diego on April 1; **Herman Charles Jones** of Tampa on January 27; **Madeline M. Leverone** of Boston, on March 8; and **Gilbert Couly Toone** of Hamburg, N.Y., on April 14. We regret the loss of these classmates and offer our condolences to their families.

At an informal class meeting after one of our reunion dinners, a motion was made that the number of class officers be reduced from four to two—a treasurer/agent and a secretary/president. It was then approved that **George Palo** be the treasurer/agent and **Ernest Knight** be the secretary/president.

A summary included in the Technology Day Luncheon Booklet for the five-year reunion classes places our Class of '28 in top honors in

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reunion gift participation (85 percent) and in donors of greater than \$100 (86 percent). Congratulations to a great and loyal class. Also, under Institute News Highlights of '92-'93 was "Rollerblades banned in MIT buildings." Just when we could surely use them to good advantage in the ever-lengthening corridors. The expansion of the campus is bewildering.—Ernest H. Knight, secretary/president, Box 98, Raymond, ME 04071

29 65th Reunion

I am very happy to report that all my eye problems have been solved, mostly by surgery. The last operation was the removal of a cataract and the installation of an insert a week ago. From this point on, it will be the slow process of healing and adjusting. I have received many letters and get-well cards during the time that my eyes were so bad that I was forced to curtail or altogether stop my secretarial duties. I am now able to answer some of the notes, some of which are dated as long ago as six months. Here is one from Joaquin J. Llano and wife, Dorothy, of Woodlands, Tex.: "The only noteworthy thing we did was to participate in a family reunion on the 4th of July which took place in New Maricet, Va., in the beautiful Shenandoah Valley. Sixty-five persons were present. At 85, we were the senior couple. We enjoyed it very much, but it took us two weeks to recuperate. We now have 10 grandchildren and 12 great-grandchildren."

I have a note from Arnold W. Conti and wife, Mary: "We live a relatively quiet life in a retirement community. Mary continues to paint and win prizes. It's gotten so we have little wall space left to hang more paintings and ribbons. I stay as busy as I want to be. Arthritis has terminated my golfing career, and with only one good eye, I could only see one half of the ball anyway. I still manage four investment portfolios and today's investments.... I spend a lot of time at the local office of Merrill Lynch. Sometimes, it is more fun than a movie. Additionally, I am the residents' representative on maintenance so I get to spend a lot of time squabbling with both management and residents. It is not always fun, but it helps to keep the blood circulating, sometimes too much.... We plan to make our 65th next year but as you know, at this point in our lives, it's a crap game, but we hope to roll a seven."

A note from William H. Jones reads, "Evelyn and I had our 60th wedding anniversary in July and we are thankful for all the blessings we are enjoying. I still enjoy listening to music, golf three times a week, and participate in most of the activities in Sun City."... Carl Howard of Bedford, Mass., who graduated from Somerville High School in 1925 with your secretary and Robert Pride of N. Palm Beach, was the recipient of an honorary Doctor of Music degree from New England Conservatory of Music last June. Conservatory President Laurence Lesser wrote in his invitation: "Your care and concern for this fine old institution is heartwarming and sets a wonderful example for the conservatory's alumni body."

A note from Chung F. Yee and wife, Zai-Chin, from Worcester, Mass., who both sent wishes for the recovery of my sight. He wrote: "I had an operation on my right eye last November which improved my eye sight very much."... A note from Jonathan F. McCray and wife, Isabel, from Bel Air, Md., says: "I had a blackout in the parking lot of the local

general hospital in July 1991. The doctor installed a pacemaker and I am all right now. A doctor has to check the pacemaker every three months. Other than that, Isabel and I are doing fine. I still help elderly people with their income taxes. Best wishes to all."

I have several letters sent by Richard Bolton of Canada during my 1992 illness: "As this is my 86th birthday, I live a somewhat limited life, curtailed by arthritis in my back and ankles, etc. Eyesight, hearing, and brain are relatively unimpaired, but I have difficulty keeping up with modern innovations. I am looking forward to my granddaughter's wedding at the beginning of June. If all goes well, I hope to attend our 65th Class Reunion next year. How I wish there might be the possibility of seasonally adjusting the thermometer so that winter could be eliminated.... Now that winter is over, and the trees are beginning to bud, I have turned my mind to other things such as furniture repair—restoration of some of the better type of furniture. Ten days ago I had my periodic cancer checkup and I seem to be good for a few more months. Who knows how long it will be?"

I regret to announce the death of the following members of our class: Gilman A. Randall, April 5; Malcolm M. Hubbard, April 24; George L. McKenna, April 27; Huguenin Thomas, Jr., March 4; James F. Hale, April 10; Jackson H. Emery, August 2, 1992; and Dr. James C. Coe, May 1.

Gilman A. Randall, 86, a retired professor and native of Whitman, Mass., died in Boynton Beach, Fla. In high school he was a cellist and was instrumental in organizing the first Whitman High School orchestra. He later was an organist in several churches in the Springfield, Mass., area and was well known for various roles in locally produced plays. Upon graduation from high school, he received several coveted scholarships and earned a bachelor's degree in architecture from MIT in 1929. He later obtained a master of education degree from Harvard University and took additional courses at Columbia University in New York City. He is survived by his wife of 60 years, Helen (Uvanello) Randall. . . . George McKenna, 86, died after a brief illness. Born in Kensington, N.H., he had been a resident of Vero Beach, Fla., for 26 years. He was a sales executive for several electrical manufacturing concerns. In Vero Beach, he was appointed as city personnel director and was an elder of the Presbyterian Church. Survivors include his wife, Elaine McKenna, and a daughter. . . . Jackson H. Emery was a retired mechanical engineer. Born in New York City, he had lived in Montgomery County, Pa., for the past 15 years. He worked for the city of Mount Vernon, N.Y. He is survived by two daughters.—Karnig S. Dinjian, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364

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This month we have two more responses from those on my expanded mailing list, Paul Richardson and Stuart Wichert. After several years at MIT, Paul left to join his family business, Richardson Farms. He later obtained a BS degree in chemical engineering from Carnegie Tech. After a few other jobs he ended up with Sargent-Welsh Scientific Co. of Chicago, where he worked until his retirement. He and his wife, Gertrude, now live in Hampton, N.H. They have two daughters. . . . Stuart Wichert's career activity was with the firm of Clark-Wichert Inc., marine surveyors

and independent insurance adjusters. Clark-Wichert was established in 1938 as successor to the earlier firm of Clark and Church. As adjusters they represented such clients as insurance companies, banks, and shipping companies in the settlement of claims in the marine, transportation, and aircraft industries. During WWII Stuart served as an officer in the Coast Guard. He and his wife, Eleanor, live in Wexford, Pa. They have two children, six grands, and eight great-grands. Stuart says that at 86 he is "still going strong!!"

Win Hartford still does considerable lecturing. His talks early this year were on "Air Pollution—the Search for a Politically Acceptable Scapegoat to the Ohio Valley ACS," "Science, Politics, and the Environment" to the American Wood Preservers Association, and "The Environmental Chemistry of Chromium" to the International Research Group on Wood Preservation. He says that this will be his last year on the speaking circuit. . . . Sol Uman, who I believe is our youngest survivor, reports that he is in reasonably good health. He and Beatrice spend their winters in Florida and summers in the Catskills. They recently celebrated their 33rd wedding anniversary "on a delightful cruise." They now have 10 grandchildren. Sol said they had a pleasant visit last year from Margaret and Morris Shaffer. . . . In February, Angelo Ricciardelli, his wife, Jane, and son Peter enjoyed their "annual sojourn" on the island of Maui. It seems that Jane was brought up in Honolulu, so the visit to Maui is like going home to her. The Ricciardellis live in Charlottesville, Va., which has enabled Ric to take nearly all the Italian courses offered by the University of Virginia. His other activities include daily jogging, recording for the blind, travel, and "visiting children (six) and grandchildren (six)."

The early months of 1993 exacted a heavy toll on the Class of '30; we have at hand notices of the deaths of four more classmates: King Tow on February 15, Josiah Barrett on March 26, Sumner Fuller on April 8, and Charles Anderson on April 28. . . . According to my records, King worked for about 20 years as a civil engineer for the El Dorado County Public Works Department in Placerville, Calif., and retired in 1972. At the time of his death he and his wife, Kum Chu, were living in San Francisco. In addition to Kum Chu he is survived by five children: James, who is a staff engineer at the Bell Telephone Labs in Holmdel, N.J.; Dan, who is a staff engineer with General Atomic Co. in San Diego; Don, who teaches physics at Brown University; daughter Billie, who is a registered nurse; and daughter Mei, who is a social counselor in the San Francisco school system. As previously reported in the Notes, King and Kum Chu had a rather spectacular 60th wedding anniversary celebration hosted by the five Tow children and their spouses. The 300 guests who attended were entertained by a series of skits enacted by some of the Tow's 13 grandchildren depicting King and Kum Chu's schooling, courtship, and migration to the United States. . . . Josiah Barrett was born on Nantucket and appears to have spent most of his life there. After graduating from MIT in Course VI he returned to Nantucket where he became a registered land surveyor, practiced surveying, and served the town in a number of capacities. Thus he was town accountant from 1932–72, registrar of deeds from 1935–83, town surveyor for many years, and also served on the board of assessors. My records indicate he was also a considerable bibliophile. In 1991 he gave the MIT Libraries a 1620 edition of Euclid's *Elements*, Books 1–6, a gift that was characterized by

Libraries Director Jay K. Lucker as "a most interesting and significant addition to our rare book collections." Josiah's wife, Evelyn, predeceased him. He is survived by a son, Paul, of Goshen, N.H., and a daughter, Jean Grogan, of Nantucket. . . . Sumner Fuller was born and raised in Woodsville, N.H. After graduating from MIT in Course I, he worked for many years as an engineer for the Mobil Oil Corp. At the time of his death he was living in Topsfield, Mass. His wife, Florence, predeceased him. He is survived by a son, Ronald, of Topsfield, two grandchildren, and two great-grandchildren. . . . For much of his life Charles Anderson lived in Lynnfield, Mass., and worked as an engineer and consultant in the design and construction of bridges, warehouses, and large commercial buildings in Massachusetts, Connecticut, New Jersey, and Maryland. Concurrently he taught architectural engineering at Wentworth Institute in Boston, where he developed stainless steel and structural steel welding techniques. More recently he was chief engineer of Industrial Stainless Steel of Cambridge. At one time he was a member of the Massachusetts State Civilian Team at Camp Perry for National High Power Rifle Matches, as well as instructor in firearms training of the Lynnfield Auxiliary Police. He also competed in rifle matches both in the United States and abroad. He is survived by his wife, Phyllis, and a daughter, Linda O'Conner, of San Francisco.—Gordon K. Lister, secretary, 294-B Heritage Village, Southbury, CT 06488

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A note from John Swanton will bring us up to date on his activities. "The July issue of the *Tech Review* had just come (a specially good one, I might add) and I must do what I can to help the need for Class of '31 news. We haven't seen classmates as much as we did in the old days so our news is apt to be boring but here goes anyway.

"Louise and I are here on Westport Island, Maine, as usual this time of the year. We had our 59th anniversary yesterday and happy to both be quite mobile; she with her Parkinson's (very mild) and me with the usual depression struggles. True, I was in the hospital in Boston for 10 days in March, but wasn't really very sick; they were just hunting for the right drugs to use, and I have been quite fine ever since.

"We took a combination of airplane trips in April to visit strategically placed daughters, one in California and one in Georgia, plus my brother in San Diego. The exciting thing since we got to Westport was my routine dentist trip to Boothbay Harbor. Just as the dentist was starting to inspect a tooth with an ancient gold cap, the cap flew off like a projectile and down my throat, in spite of frantic efforts to avoid it. I was sent posthaste to Brunswick Hospital, where they were said to have the right machinery to recover it. After x-rays and unusual preparation, they put me out. In a short time with much skill they retrieved this giant gold cap, actually from my lung, it turned out. I was lucky, I've been told. At least, it was a month ago now and I've had no ill effects."

My own news has been a bit unusual. Mildred and I had a visit this past week from a former classmate of hers at Arkansas State (a teachers college in Conway, Ark.), Dorothy Peck Cheek, now living in Dallas. Her arrival coincided with the news that my sister's husband, Paul H. Provandie, had passed away up

in Belgrade, Maine (on March 25). Since Dorothy had never visited this corner of the world, we took her along with us to Maine. Paul had been in the advertising field in Boston, but after retirement moved to Belgrade, Maine. He eventually purchased the Belgrade Lake Inn, which his son now runs in season. His son made a specialty of roast duck, and when General Schwartzkopf retired from the Arabian Gulf War, he sent one to the General, who liked it so much he ordered several more.

I had one death notice this month—that of Charles Claudius Fingar, Jr., who was briefly a member of our class. He died in June in Hudson, N.Y., but we had no information about him except the tale he sent out at our 25th anniversary. He was Course VI-A (EE) and at that time commented that he had been "a rolling stone that gathered no moss," since leaving Tech. He said he was a believer in "variety as the spice of life," proof of which is occupations engaged in, to wit: wholesale fruit and produce manager, electrician, fur storage warehouse supervisor, Telautograph Corp. technician, antique dealer, stock market analyst and trader, Canada Dry Ginger Ale Co. accountant, G.E. Co. Transmitter Test Laboratory worker, New York Central R.R. Co. relief signal station operator and station agent, and Universal Atlas Cement Co. shipping and storeroom accountant. Quite a lot for one individual. He retired from Atlas. There was no report on family.—Wyman P. Boynton, secretary, 668 Middle St., Portsmouth, NH 03801

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Russ Robinson and his committee have come up with a well-thought-out plan for our mini-reunion in the middle of April 1994. It will be based at the Radisson Hotel in Tucson, Ariz. For five days there will be a full program of tours, banquets, "Happy Hours," recreational facilities, and entertainment. All this at the most reasonable total cost of about \$900 per couple. Travel costs to and from Tucson will vary for each individual. The maximum cost for travel per person should be less than \$400. Very soon you will receive a letter with full details. It will be of vital importance that you indicate your interest in such a reunion immediately. Talk it up—it could be great!

June 4th—Technology Day was a beautiful day. The lectures in Kresge Hall were centered on the ocean—the challenges of its depth, its impact on the weather, and its promise for innovation for mankind. Read all about it in the *Technology Review*.

There was an impressive morning memorial service for MIT alumni/ae that were reported deceased from March 31, 1992, to March 26, 1993. Our 1932 classmates were listed as follows: Thomas T. Amirian, Michael Anthony, Cecil Boling, Minot R. Bridgham, Joseph W. Cogan, Leon J. Cohen, Allan L. Dunning, USN, Robert H. Hansen, Albert D. King, Arthur La Capria, Herman C. Phillips, John R. Rafter, Donald C. Sanford, F.C. Tucker, Sr., and Harland H. Young, Jr.

The following members of the Class of 1932 attended the activities of Technology Reunion days: William Bannon, Wendell Bearce, Donald Brookfield, John Brown, Francis Gowen, Harry Johnson, Albert O'Neil, Melvin Castleman, Thomas Weston, George Falk, and Arthur Marshall.

At the luncheon we learned how well the alumni/ae were supporting MIT. We also

learned how many national honors and government appointments were given to MIT faculty and alumni/ae.

At the Cardinal and Gray dinner on Friday evening when things became very quiet, our **Tom Weston** took the stage and gave a one-man show for almost half an hour. He had everyone laughing. He really saved the night.

John Brown conducted discussions at the class meeting on a mini-reunion in April 1994. He appointed committees. He reported about \$1,000 in our class treasury.

Benjamin Wilbur writes us that he has stopped shovelling snow, or riding a lawn mower, and even worse, stopped driving a car. But jumble x-word puzzles are still a pleasure.

We have received the sad news that **Victor Gelin** died November 26, 1992, in Winter Haven, Fla.; and that **William Wells** died November 1, 1992, in Wilmington, N.C. When we receive more obituary information we will pass it on.

All for now. Write! Write! Write!—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Please send news for this column to: **Berj Tashjian**, secretary, 1245 Briarwood Ln., Northbrook, IL 60062

34 60th Reunion

Our president, **John Hrones**, expects me to continue to at least the class meeting in 1994. In the meantime I will do my best to wear Bob's mantle with credit and to enjoy the help that you will give me by sending in accounts of your activities. I am grateful for the fact that some of you have recently submitted material directly to the Alumni/ae Office, such as **Carl Wilson's** account of a recent mini-reunion.

John forwarded to me what was an impressive professional resume concerning **Joseph F. Dauber**, who passed away January 17. He spent the early years after graduation in Chicago where he had become VP for engineering, R&D, and sales of Acme Scientific Co. He was active in the field of optical instrumentation. He developed improvements in interferometers that were marketed and sold based on his designs. One of them was illustrated in the 14th edition of the *Encyclopedia Britannica*. In 1949 he moved to Los Angeles and established his own manufacturers representative company, Abbott Instrument and Engineering, specializing in the sale of optical and measuring instruments. He also did consulting in this field. In 1973 Dauber was asked by the owners of Gaertner Scientific Corp. of Chicago to become its president, and as president restored the company to profitability. The company was sold in 1978 and he resumed living in California.—**George G. Bull**, secretary, 8100 Connecticut Ave., Chevy Chase, MD 20815

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Vinton K. Ulrich and his wife, Evelyn, celebrated their 50th anniversary on April 3 by going through the wedding ceremony for the third time, before 100 family members and friends. In 1943 they eloped and were married

by a justice of the peace in Conway, N.H. A few weeks later they repeated their vows at a ceremony in a Catholic rectory. Vin claims to have avoided boredom by preparing income taxes for H & R Block for 14 years as well as attending classes each fall in preparation. Vin says he and Ev have had their share of health problems in the past decade but manage to live a normal life. Over six years ago they moved to Damascus and purchased a "modest town house about an hour's drive from Washington, D.C., and Baltimore, and very much in the country." As bulletin editor for the Damascus Lions Club for some two and a half years he can fully appreciate what it takes to supply the notes of our classmates. "I do enjoy very much reading about our classmates." They are spending a week on Maui in the latter part of June.

You will be interested in knowing that the following '35ers were Telethon volunteer callers last year: **Benjamin Blocker**, **Phoenix Dangel**, **Arthur Deming** and **Forrest Goldsmith**.

Les Brooks reported that our class treasurer was involved in a head-on auto collision during a heavy rainstorm. "He is O.K. now after a short stay at a hospital to get patched up. The other driver died." **Prexy John F. Taplin** received word from **Christine Foglia**, Program Manager Alumni/ae Affairs at MIT, that for the 1991-92 year our class had the highest participation rate in the Alumni/ae Fund. Of all 72 classes from 1921 to 1992 our rate was highest at 64 percent. However, for the current fiscal year the class of 1938 is ahead of us by 1 percent. So, John has sounded the alarm for an "Emergency Corrective Action Program" to help us maintain our position of leadership. We have 259 classmates each of whom we are asking to add \$10 to their annual gift making a total of \$2,500, enough to more than make up the difference. I sent John's \$100 check to MIT with information on the 1935 Program and called **Hal Bemis**, our Class Agent, to tell him about it. Hal Bemis deserves full credit for the past efforts achieved by our class.

Maurice S. Alexander writes, "One of these days I'll write and tell you all about this fine old Cape Cod."

I am sorry to report two deaths among our classmates: **Douglas Chalmers** died December 18, 1990, in Newport Beach, Calif.; **Oliver Hoag** died March 19, in N. Bennington, Vt. Oliver is survived by his wife, Isabel, a son and daughter, and five grandchildren. I am sending our condolences.—**Allan Q. Mowatt**, secretary, 715 N. Broadway #257, Escondido, CA 92025-1880

36

Readers of the April 4 *Washington Post* and watchers of CNN in early May saw **Bob Gillette's** son Ned and wife, Susie, about to start a 16-month camel caravan 6,000 miles westward across China, some former Soviet Socialist Republics, Afghanistan, and Iran to Antioch, Turkey. It is the 2,000-year-old Silk Route, later taken by Marco Polo. If all goes well, their chronicle will appear in *National Geographic* in 1995, but it is an adventurous undertaking across torrid deserts, frozen mountains, and some political hotbeds. . . . Earlier this year I mailed an Australian newspaper article on **Dennis Conner**, America's Cup competitor, to 13 classmates known to be sailboaters. (If there are more, let me know to include you on this list.) **Ed Rowe** responded that his yacht-designer son hears

that a less expensive, single-design Cup boat may be proposed.

Virginia and **Dick Denton** wandered round the world in 63 days last winter by airplane, boats, jeeps, etc., emulating **David Niven**, sort of. Dick's main suitcase was lost enroute from the United States to Fiji, where a hurricane shut them off from the airport. Then they traveled to Auckland, Sydney, Bali, Bangkok, New Delhi (riots in Old), and camera-hunting in Nepal and Kenya. Some scuba diving in the Seychelles, and stays in Istanbul, Bosphorus and Athens, after pyramids and Aswan in Egypt, then home. Meantime their oldest grandson winds up sophomore year at MIT and his younger brother enters this fall.

On the way from North Jersey to a grand-niece's June wedding in Virginia, I stopped in Philadelphia, Wilmington, Del., and D.C. for meetings with classmates in those vicinities. **Charles Saffer** (Course V) hosted a luncheon at the Racquets Club, with **Bill Tier** (X-B) and **Howard Turner** (V) attending. **Dan Carroll** (VI) and **Hamilton Migel** (II) could not be there, but brought me up to date by telephone. In Wilmington that afternoon I saw **Art Carota** (XVII) at home and over dinner at the University Club, where he put me up for the night. Next-day lunch at the Du Pont Country Club was organized by **Leonard Chandler** (X-B), with **Stan Lukoff** (XVII) and **Bernard Sturgis** (V) also attending. **John Roberts** (X-A) was moving to a retirement home, with children assisting in disposing of surplus, but more from him later. Then on to Maryland, where **Bill Nichols** (II) was at home in Lutherville, and to Washington with lunch at the Marriott arranged by **Mac Nyhen** (VI-A). Also attending were **Kathleen Shott Cummins** (VII), **Joe Kingsbury** (VI), **Henry McGrath** (X-A), **Paul Robbins** (I), and **Bob Walker** (XVI). With column space limited, it may take until next February to print all of the accumulated intelligence, but hang in here, please.

Charlie Saffer recalled the excitement of doing graduate research under **Sir Robert Robinson**, the brilliant British chemist who in 1947 won the Nobel Prize. Such Oxford experience, added to three degrees from MIT, led to a career in R&D management at Witco Chemical. He spoke of **Lou Stahl** ("kindest, most generous man") and the times they left physical chemistry lab early to catch matinees (less expensive) at the Old Howard. . . . **Bill Tier** is retired from Philadelphia Tramrail Co., where he did engineering, sales, and production of overhead conveyors for medium-weight goods, meat—you name it. One of their clients was Riegel Paper in New Jersey, where Bill's counterpart was **Towers Doggett**. Bill started at St. Joseph's College in Philadelphia, and joined classmate friend **Henry Jansen** (deceased 1977) applying for transfer to the Institute. Working on *The Tech* newspaper, he specialized in composing headlines. Like many students, he hoofed the Harvard Bridge to save carfare, while rooming on Marlboro St. for \$11/week including meals.

Howard Turner was with us three years to add a Tech PhD to an SB from Swarthmore. Then years of research for Du Pont, Consolidation Coal and as VP and chief technical officer of Jones & Loughlin. In 1965 he took on the presidency and chairmanship of Turner Construction in New York City. He was a member of President **Ike's** Science Advisory Committee, and in 1967-8 of President **Johnson's** high-level (surgeon general, secretary of education, etc.) committee to visit South Viet-

nam and recommend ways to help the people. Their report that the people disliked each other but also the United States never got through the mill. Howard was elected to the National Academy of Science in 1972.

A toast to the lives of **Walther Mathesius**, Course III, and **Jim Thomson**, Course IV. George Ropes, '33, passed along information from Wally's daughter Peggy that he died April 18 in Beaver, Pa., and George made a special contribution to the Alumni/ae Fund in memory of his longtime friend. I commend Wally's 50th reunion biography to your attention, and his "Highlights" speak for the nature of the man—"work assignments in 40 countries worldwide, Queen's birthday, four-day weekends in Tasmania and on Great Barrier Reef. Seeing my sons bag their first grouse and woodcock."

James M. Thomson died March 16. He transferred from MIT to Yale Architectural School under Frank Lloyd Wright, and he built many homes in New England. He was "Citizen of the Year" for his long service on the Farmington Historical Society, Museum, and Historic District Commission, and the Hartford Art School, Wadsworth Athenaeum, and Mark Twain House. During World War II he flew troops between the mainland and Hawaii.—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

37

At our mini-reunion on Technology Day, seated together in the '37 Cardinal and Gray section, we spent the time eating and catching up on one another's activities. The "gang" consisted of **Dave McClellan**; **Ed Hobson**, just back from a trip to Germany and Europe, **Roger Wingate**; **Mel Prohl**; **Dick Young** and his wife Marge, both still happy about their move to a living-care home at Fox Hill; **Len Seder** and wife Genevieve, equally happy about their move to a living-care home at Brookhaven; and **Bob Thorson**, also happy at moving to neither of these. Then there was **John Benson**, once of GE Jet Engine Development, back from celebrating the 50th anniversary of the jet engine at Edwards Air Force Base.

Heard from **Edwin Olmstead**, now living in Carlisle, Pa., having retired in 1972. He eloquently expresses what many of us have experienced: "Many factors, none of them large, tarnished the glitter of my involuntary second bachelorhood, even our dream house on 3.5 country acres. Have relocated at 'independent living' in a new retirement community, so my past two months have been dedicated to finding and disposing of lifetime accumulations from all five of us. Did no one ever discard anything? I can fault no others. As of this past weekend, four medium-size vans, two small trailorloads of my own gas engines, machine tools, and treasured magazine runs have found homes with friends. The resulting reduction of clutter is not readily apparent."

From San Diego comes a welcome letter from **Hank Stuart**, who says that "Millie and I are doing fine." He continues to be active in Rotary, the San Diego Maritime Museum, and the San Diego Amateur Movie Club. "My medium is video Hi8." Millie continues her interest of many years in Ikebana International, Japanese stylized flower arranging. Hank is thinking about involvement in an ambitious ongoing development of acreage into a tradi-

tional Japanese garden, emulating those seen around Buddhist and other temples. He enjoys MIT meetings and affairs and was especially pleased with **Pete Reitz's** gift tape at the 55th Reunion.

Carl Sontheimer reports from Greenwich, Conn., that he and wife Shirley are collaborating on a cookbook to be published next year. Actually, he didn't say Shirley was involved, but can you believe otherwise? He did say that he is president of CHC of Connecticut, but didn't explain what that is. Thanks anyway, Carl, for taking the time to write.

Had a very interesting letter from **Margaret Kingman**, who lives in Hanover, N.H., in the winter and operates a summer place in a mansion in Richmond, Mass. Called **Peirson Place Inn**, located at 1238 State Road, it is an historical landmark of Berkshire County, about six miles from Tanglewood. It is a great place for nature lovers and history buffs. (I can supply copies of the historical background to anyone interested in visiting.) Margaret retired from State University College (SUNY) in 1976 as associate professor of geography. She spent 25 years of service as geographic officer with the U.S. government (OSS and CIA), resigning under the Johnson administration.

Regretfully, we report the death of **Arthur R. Hunt** in March. He studied mechanical engineering at MIT and went on to become head of Tool Engineering at Chance Vought Aircraft during the war. Afterwards, he became involved in several aspects of skiing, including ski design, lifts, and more. He is survived by four children and eleven grandchildren. . . . **Robert F. Brown** passed away at his Oregon home in April. He held degrees from the University of Colorado and MIT and worked until retirement for the Martin-Marietta Co. A "celebration of life" memorial was held by his Quaker friends in Eugene, Ore.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890; **Leonard A. Seder**, assistant secretary, 1010 Waltham St., B342, Lexington, MA 02173

38

The 55th Reunion is now just a memory. BUT WHAT A MEMORY! Reunion Chair **Norman Bedford** and his committee of **Norman Leventhal**, **Frank Gardner**, **Paul O'Connell**, **Lou Bruneau**, **Dave Wadleigh**, **Don Severance**, **Ed Hadley**, and **Al Wilson** put together a magnificent program. And with the superb support of alumni/ae reunion staff—**Eliza Dame**, **Chris Foglia**, and **Carla Grayson**—the plans of the Reunion Committee proceeded without a hitch. **Bonnie Jones** of the alumni/ae staff was the support person for all of our events.

We reversed the usual order of events and had our off-campus activities at the start of the week. On June 1 a group of us departed from Cambridge by bus to Woods Hole. There we were met by other classmates and proceeded by ferry to Martha's Vineyard. The bus took us all the way to the Harborview Hotel in Edgartown which greatly simplified baggage handling.

Others had arrived the previous night in a pouring rain. The weather when we left Cambridge was overcast, but by the time we arrived at the hotel, the sun was shining and stayed that way until Saturday. (Nice arranging, Committee!) There were about 70 of us altogether.

After lunch, the remainder of the day was

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spent investigating Edgartown. That evening we had a clambake that was held in a private dining room, since it was too windy to be on the beach. The next day was spent in shopping, golf, tennis, sailing, and exploring the island by bus. That evening we had the Class Banquet with a most informative talk by Mrs. Samuel Halperin on the history of the island. This was followed by a presentation of plaques to Norman Bedford in appreciation for his chairmanship of the Reunion Committee and to Horace Homer for his five years of service as class president. David Wadleigh then presented the Nominating Committee's report for the new class officers: chairman—Norman Leventhal; president—Fredrick Kolb; vice-president—Paul O'Connell; treasurer—Armand L. Bruneau; secretary—Horace Homer; and class agent—Donald Severance.

The slate was approved and Fred Kolb took over as the new president.

Fred's first official duty was to hand out the reunion souvenirs. These were gifts from Norman Leventhal, consisting of handsome replicas of the earliest-known map of the coast of New England from his extensive collection of ancient maps, and they were beautifully framed. THANK YOU, NORMAN.

Thursday morning we reversed the bus trip to Cambridge, with a box lunch on the way. That evening we had the class pre-Pops dinner followed by Pops and a post-Pops reception. Friday morning was spent listening to a series of talks in Kresge Auditorium on oceanography, it being the 100th anniversary of the Department of Ocean Engineering. The highlight was the talk given by William Koch, '62, winner of the America's Cup in 1992. The Cup was on display. It is no small cup, standing almost four feet tall.

After the talks we assembled for the Technology Day Luncheon at the Johnson Athletic Center. Following the luncheon the class began to disperse. Some stayed for the Cardinal and Gray Dinner and a few stayed until Saturday to take in the "Techsas" Barbeque. All in all, a most satisfactory reunion.

Word has reached us of the death of Arthur H. Christgau from a heart attack on April 4. He was a member of Sigma Alpha Epsilon fraternity. He worked for Boston Woven Hose for two years and then joined Westvaco Corp., where he remained for 41 years. He was responsible for the economic evaluation of capital jobs. Incidentally, Arthur had the dubious distinction 10 years ago to read his obituary in the *Technology Review*.

Word has also been received of the deaths of Chester H. Bean on February 2, 1987, and Norman F. Stevens in 1993. No information is available on either one.

A letter received from Anne (Person) Zemansky, '39, tells of several health problems, but she and Stan, '37 (XVI), celebrated their 55th wedding anniversary a short time ago. Their daughter Sondra is Class of '74.

In closing this, my maiden endeavor as your new class secretary, I want to pay tribute to your long-suffering former secretary Donald Severance and assistant class secretary G. Edwin Hadley. A great deal of work is involved in preparing each set of class notes. It is to their credit that they never failed to get them out.

As a footnote to the above: Don has had a recent knee replacement and Ed is going to have one. Do you suppose that this is an occupational hazard?

Please send any news to me. Make my life easier.—Horace H. Homer, secretary, 702 Quaker Rd., North Falmouth, MA 02556

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55th Reunion

Walt May retired with many honors after his career with Mack Trucks in Allentown, Pa. Walt and Hazel sent a clipping from the June 1 *Allentown Morning Call* about classmate William K. Cutten, who died September 19, 1992. Cutten left about \$1.5 million each to MIT in Cambridge and Bates College in Lewiston, Maine. This is in addition to \$250,000 Cutten gave to Bates, and \$350,000 he gave to MIT in his final years. He was a genius with a fine sense of humor. He served as a major in George Patton's Third Army during World War II. Cutten worked as an engineer for Lee Carpet Co., which later became Burlington Industries. . . . Mike Herasimchuk and Jean moved from Irvington, Va., to Bethlehem, Pa., where Mike heads the Juniors' Golf Division he founded about 20 years ago.

George Beesley and Eleanor report that June Week 1993 activities of the Cardinal and Gray Society were attended by Ruth Pitt, Ginny and Fred Grant, Fred Schaller, Mary and Martin Lindenberg, Edith and Aaron White, and Herb Jaffe. During the C&G dinner Friday evening, Aaron White provided dinner music by playing tapes of Big Bands of the '30s and '40s. . . . Fred Grant and Ginny report the catering chief of the Newport (R.I.) Marriott Hotel pledged to feed us well during our 55th Reunion.

For our 50th Reunion, a 1939 *Technique* 89-page book was written. Acknowledgements for work well done appear up front. Before that 50th Reunion, a lengthy questionnaire had been distributed to all '39ers. One hundred sixty-two classmates replied. Because Irv Peskoe had written a superb summary for our 50th Reunion, he was invited to lead the team to summarize replies to the questionnaire for the 50th. It was my treat today to reread the acknowledgements and pages 12-18 and 54-64. Rereading and remembering are recommended.

Dominic Donatello, Jean, and their five sons inspire others today as Horatio Alger stories inspired other generations. To create successes, Dominic tooled up in Course X, served in the U.S. Air Force for five years in World War II, and then started manufacturing household bleaches in small tanks in Anchorage, Alaska. Aware of unfulfilled local needs, he provided new products and services. During the following 45-plus years, he financed from earnings and built plants to render meat, make soap, blend feeds and fertilizers, pack meat, and operate retail stores. In 1965 President Johnson acclaimed him Small Business Man of the Year. After our 50th Reunion, the governor of Alaska became aware of misguided efforts to destroy the Donatello enterprises. He invited Dominic for a one-on-one interview. The destroying forces were neutralized. The Donatellos are among '39er families who reflect extraordinary credit on their classmates and MIT. They have stimulating stories to tell at our 55th Reunion.

Ted Wroblewski retired from Sylvania to consult on design of lamp ballasts, transformer and voltage regulation, and power-line suppression of current spikes. He co-authored a book. Every now and then Ted is pleased when some former client remembers past accomplishments and asks him to solve some current problem. (No pun intended, Ted).

Seymour Sheinkopf and Sylvia wrote in May: ". . . We are planning a trip to London in June. Then we'll be in New England for July and August. I attach a thank-you letter from

an MIT student whose education is being helped by our 1939 Class Scholarship Fund: "Dear Mr. Sheinkopf: I received a scholarship from the 1939 Scholarship Fund. I am honored and thank you and your class for making it possible for students with financial needs to continue their education. To tell you a bit about myself, I am in the school of architecture and participate in extra-curricular activities including MIT Concert Choir and the Musical Theater Guild Technical Crew. I hold the position of junior VP in the Society of Hispanic Professional and Engineers. I was also VP of Club Latino. Thank you and the Class of 1939 for your wonderful gift..."

Orv Dunn and Pat built a new house in Anaheim Hills, Calif. Twelve hundred square feet are allocated to Orv's scale-model railroad. Construction of the First Division is under way and Orv is trying to persuade Pat, a practicing professional artist, to decorate the background scenes. In 1939, the careers of Orv Dunn and **George Estes** started when they drove from MIT to California, where Orv went with Douglas and George with Lockheed.

Two days before the expected arrival of **Jim Barton** and Mary, **Sid Silber** experienced a retina separation in his left eye. Delicate surgery was completed just before Jim and Mary arrived. The four enjoyed a four-day visit before Jim and Mary returned to Seattle. Sid convalesced so quickly that he and Jean were able to start foreign travels previously scheduled. Before this writing, they toured in Spain, are in Paris now, and will visit Normandy and part of England before returning to their Maryland estate.

Chuck Mercer and Louise are active in Little Compton, R.I. When I called, Louise had just finished a tennis match and Chuck a day's haying. As we reminisced, I found that Chuck had been involved in building Spokane's first major aluminum reduction plant. About five years after that, Hilda and I had returned from a year and a half in Rio de Janeiro and were based in Portland, Ore., where I was managing sales of pitch and petroleum coke to make anodes in the aluminum plant Chuck had built. . . . **Bob Withington** and Betsy are being tutored in Russian as they prepare to voyage on Russia's Volga River during autumn 1993.

John Herlihy and Lucille are in Lansing, Ill., retired except for when grandchildren visit. During World War II, John served with honor in a B-17 Bomber Group in England and he continues to earn his Bronze Star medal by helping arrange annual reunions of his wartime buddies. . . . **John Alexander** and Nancy joined Hilda and me to listen to harmonies at a Northwest Barbershop Harmony contest. The Alexanders are planning an autumn trip to New Zealand to visit friends they made during a 22,000-mile voyage across the Pacific in their 47-foot ketch.

George Blake and Virginia are retired in Pittsburgh, Pa., after his career with Westinghouse. They winter in Vero Beach, Fla., and spend some summers in New England. George volunteers work for SCORE, is researching family genealogy, and has great stories about his adventures during World War II. . . . **Art Zeldin** and Helen cruised through the Panama Canal and toured in Costa Rica and the West Indies. They are about to visit Norway and Denmark and will tell about it all during our 55th in June 1994.

Barry Graham wrote to report the death, on April 8 in Toronto, of his wife, Jean. He said: "... For the last 10 years since Jean lost her sight, she was entertained and informed daily by using a special machine and long-playing book and magazine tapes provided by the

CNIB. The purpose of the Barry Graham Foundation is to support this excellent Canada-wide program. . . ." In these times and as we pass our mid-70s, let's help classmates over grief when it comes. Barry's address is 24 Burnham Rd., Toronto, Ontario M4G-1C1.

Fred Grant forwarded an obituary from the *Boston Globe*: "... **Harry W. Tileston, Jr.**, 74, of Weymouth, Mass., a retired electrical engineer, died May 9 in Massachusetts General Hospital. Born in Derry, N.H., he graduated from MIT in 1939 with a degree in electrical engineering. Mr. Tileston lived in Weymouth for 35 years. He worked as senior electrical engineer for Stone and Webster Engineering Corp., retiring in 1976." . . . We are sad to report the death of **Gerald L. Tawney, ScD**, on December 22, 1992, in Santa Barbara, Calif. There were no details.—**Hal Seykora**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

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John Danforth sent me a clipping about a celebration in Boothbay Harbor, Maine, to honor **Jay Zeamer**, a Congressional Medal of Honor recipient. Last month, this column reported on the events that led to Jay's receiving the medal. June 16, the 50th anniversary of the event, was declared Jay Zeamer day in Boothbay Harbor. Jay's co-pilot surprised him by flying in from Arizona for the ceremonies. There were letters from many dignitaries, including the governor, Senator George Mitchell, and former President George Bush.

Word has come to me that **Amos E. Joel, Jr.** has been named as a new member of the American Academy of Arts and Science. I just called him to ask about the organization, but he doesn't know much about it either. He will be inducted at a ceremony in October, so perhaps by then, he will have learned more about it.

The Alumni/ae Office has recently received news of the death of **Delano Wight** on January 4, 1990. There is no further information.

I must also report the death of **M. Spalding Toon** of Belleair, Fla., and Chatham, Mass. The *St. Petersburg Times* reports that he had been president of the Bessemer and Lake Erie Railroad; the Duluth, Missabe & Iron Range Railway; the Elgin, Joliet and Eastern Railway; the Union Railroad, seven other railroads, and the Pittsburgh and Conneaut Dock Co. He was a director of the Association of American Railroads.

Alan Thewlis of San Diego, Calif., writes, "I plan to attend the 100th anniversary of the naval architecture program, and then go on to Europe. My wife of 51 years, Winifred Hawley Thewlis, did not survive difficult and dangerous second replacement of heart valves, and died on January 24, 1993. My forthcoming trip, I hope, will clear my outlook on life."

I received a letter from **Woodson W. Baldwin**, '39, commenting on my July report on the death of **William W. White**. **Woody** writes, "I first met Bill White when I was about 14, when we moved to 40 Winchester St., Brookline, Mass., about 1930. He also lived on Winchester Street. I went to Brookline High, and he went to a private school, but we still saw a lot of each other. We were both members of a bunch of seven guys who went around together, two of whom also attended MIT. School nights, after homework, we'd gather at an eatery at Washington Square for dessert and coffee. After World War II, we all settled in different places in the United States. I ended up in California. After a few years, Bill showed up here also. I remember visiting him

and his family in a huge house (it had four bedrooms, if memory serves) right on the beach at Malibu, which he rented from some movie star for several months a year. The kids (the boys, anyway) were keenly interested in sailing. The last time we saw Bill and Jayne was at a wedding of a daughter of theirs, and it must have been back in about 1968 or 1969, I think. I have a couple of later addresses for the Whites, one in Washington state (late 1969), and one in Nevada (1984), but I was never able to contact him. Apparently they moved around quite a lot." I was particularly interested in these remarks, because I lived directly behind Woody at that time, but never knew him nor Bill White, even though I had other friends in the same block of buildings.

Keep those letters and calls coming to: **Richard E. Gladstone**, secretary, 250 Hammond Pond Parkway, 1205 S., Chestnut Hill, MA 02167, (617) 969-5161. Please note that this is a new address and phone.

41

Luke Hayden notes on his response to **Will Mott's** thoughtful letter on the class giving program: "Most important news of the Haydens at this time is that Dorothy and I hope to celebrate our 50th Wedding Anniversary on May 1. Major results [editor assumes Luke refers to the original ceremony], have been three daughters (Suzanne, Patricia, and Mary Eileen), one son (Luke III), and 12 grandchildren." We congratulate the Haydens on reaching this milestone!

On a more somber note, MIT informs us that **Bob Simon** suffered heart failure on March 26 while on a ski trip to Mammoth Lakes, Calif. He was 72 and lived in Point Loma, near San Diego.

I particularly enjoyed seeing Bob, a fellow chem engineer, at the 50th Reunion because of one of those coincidences that add spice to our lives. About 20 years previously my son Rick shared a paper route with a schoolmate. Rick invited him, Jon Simon, to dinner one evening, as his parents were moving the family to California. In a typical, tongue-in-cheek, teenager discussion, critical of precise MIT fathers with impossible standards, it came out that these fathers were also classmates. We were always disappointed that the impending move prevented renewing our friendship in Bethesda, Md.

Shortly after receiving an SB with us, Bob received an SM, also in Course X. He earned a PhD in chem engineering from Oregon State in 1949. Most of his professional career was spent in the field of atomic energy, starting in 1944 prior to joining the army. With this background he was assigned to the gaseous diffusion plant at Oak Ridge, Tenn., and helped produce the U-235, which was used in the bomb that helped end the war. After receiving his PhD he worked on radioactive fuel, waste reprocessing, and the Naval Reactors Program at General Electric's Knolls Atomic Laboratory in Schenectady, N.Y.

In 1959 Bob moved to the General Atomic Co. in San Diego, working on advanced nuclear power plants cooled by helium. He was later named director of their Gas-Cooled Fast Breeder Reactor Program. From 1983 to 1985 he was a consultant to Gas-Cooled Reactor Associates, a utility-sponsored group.

Bob was a member of ANS, AICHE (chair and charter member of the San Diego Section), and author of more than 20 papers. His other volunteer activities included Boy Scouting (scoutmaster and troop committee chair) and

co-founder and president of the GA Retirees Association. In retirement, he and his wife of almost 50 years, Eleanor, were active in downhill skiing and hiking.

The class expresses its deep sympathy to his wife, their two sons, and two grandchildren.

Class President **Sepp Dietzgen** reports, "The Pre-Technology Day Class of '41 Mini-reunion Dinner, on June 3, 1993, was canceled because of projected low attendance. This was partially caused by a conflict with 50th reunions of prominent classmates' wives at other colleges. Technology Day 1993 itself, commemorating the 100th anniversary of the MIT Department of Ocean Engineering, was an enormous success—standing room only at Kresge! Dr. William I. Koch, '62, the skipper, presented a model of his 1992 America's Cup winner *America*³, to MIT. His video of the races, together with his acerbic commentary, were the funniest presentation ever seen at MIT. The audience was in stitches—collisions, near misses, expensive mistakes, incredible photography!" Look for a more complete report on Technology Day 1993 in *Technology Review*.—**Charles H. King, Jr.** secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

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David Baltimore would like to hear from anyone interested in working on a Class Reunion to be held prior to our next regularly scheduled one in 1997. Please get in touch with Dave at: 34 South River St., Wilkes-Barre, PA 18701; or phone him at: (717) 823-2222.

Since retiring as an associate professor of electrical engineering at the New Jersey Institute of Technology in 1986, **Erv Rips** continues playing oboe and English horn in chamber music groups, orchestra, and in bands. He's also trying to finish his historical novel about the Turkish siege of Vienna in 1683. . . . **Lou Stouse** is working on the **Jack Sheetz Memorial Fund**. All those interested, please get in touch with Lou at: 2420 Buena Vista Rd., Winston-Salem, NC 27104.

Classmates at the Jack Sheetz celebration included: **Lou Rosenblum**, **Jerry Coe**, **Stan Golembe**, **Irv Fageron**, **Mort Goulder**, **Frank Hutchinson**, **John Lacy**, **Dean Lewis**, **Ed Pepper** and **Harry Remde**.

Art Power, writing from Boulder, Colo., is still running his consulting firm in chemical process/project engineering. He mentioned one particularly interesting project: techno-economic analysis of the conversion of biomass to fuels and to chemicals for the National Renewable Energy Laboratory, which is an agency of the Department of Energy. Art, an Educational Council member since 1969, is also still active at this.

A tardy obit: **Vic Frank**, who graduated in Course V and also got a PhD in chemistry at Tech in 1948, passed away in Silver Spring, Md. During his very active career, Vic was associated with **Dewey & Almy**, **W.R. Grace**, **Merck & Co.**, and the **Mayo Clinic**. Vic is particularly known for his work on the partial synthesis of cortisone. Our condolences to his wife, **Miriam**, and to the family.—**Ken Rosett**, secretary, 281 Martling Ave., Tarrytown, NY 10591

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There being no other news at this time, I bring you at last what I modestly call the Long and Impatiently Awaited Reunion (LIAR) Report.

Jim Hoey thought the coverage of the 45th Reunion was too abbreviated, so the treatment of our nine-day May/June celebration will extend over several installments.

At the outset, let me say I consider the whole affair a magnificent success, with maximum credit going to **Ralph Leader** and his Reunion Committee. We had the largest percentage turnout yet of any 50-year class. The Alumni/ae Association staff also deserve our praise for their tireless efforts in keeping us on track and heading in the right direction.

On Graduation Day, May 28, class members assembled in Rockwell Cage, our new red coats mingling with the black robes and multi-colored hoods of the faculty, as we lined up for the academic parade. Showing miraculous agility, **Ralph Leader** climbed to an elevated position to give us instructions, while **Stan Proctor** circulated among us, still passing the hat for the Class Reunion Gift.

From Rockwell we marched across Mass. Avenue, along Memorial Drive, and into our reserved section in Killian Court. Along the way, our incredible seniority and stubborn tenacity were applauded by a waiting crowd of graduating seniors and spectators. Savoring what might be the only public applause many of us would ever receive, we wondered if those youngsters could imagine themselves doing the same thing in 2043.

We joined an enormous throng in Killian Court—about 2,000 degree recipients plus two or three times as many family and friends. Under threatening skies, Corporation Chair **Paul Gray**, '54, pointed out that there were no indoor facilities large enough to handle the crowd in case of rain, and he urged everyone to make use of the plastic MIT ponchos that were provided free of charge. He recalled a wet graduation of some years ago when a rain-drenched father dismissed it as trivial compared to the four-year soaking he had already received. During this discourse we were joined by **Al Emond** in a wheelchair pushed by two sons, and wearing a large, wide-brimmed Western hat to ward off the invisible sunshine.

After the programmed speeches and ceremonies, the multitude began to disperse, slightly delayed and detoured by the massive security precautions on behalf of Mexican President **Carlos Salinas de Gortari**, who had been the principal commencement speaker. At the following reception in Eastman Court we found a canopy and table of goodies reserved exclusively for our class. Age hath its privileges.

That afternoon and the next morning a number of early birds drove up to Black Point Inn, the reunion site located on Prouts Neck, Maine. The road passed through the little town of Scarborough, which, we were warned, has a very strictly enforced speed limit. Sure enough, several police cars were on watch, but there were no reported citations that weekend.

Among the early arrivals were several of the Albq Gang: **Ros** and **Jim McDonough**, **Ellen** and **Jim Spitz**, **Sue** and **Harry Ottinger**, **Sue** and **Jim Malloch**. Also present were **Mildred** and **Carl Markkanen**, and **Marilyn** and **Jacques Maroni**. Regrettably absent were **Jack Tyrrell** and our departed friend **Red Brindis**. On Sunday there were a few more arrivals, including **Joan** and **George Marakas** and **Ann** and **Greg Gagarin**. Ann shares with me an interest in military history, and we spent some time exchanging titles from our current reading lists.

It was a relaxing pre-reunion weekend in a beautiful seaside setting. We enjoyed cocktail hours in the Bayview Room, great meals, TV, tennis, dancing, church attendance, and lively

conversation. We were also visited by a delegation of McDonough children and grandchildren who live in the area, and got our first view since 1988 of the famous McDonough kilt.

To be continued.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

44

50th Reunion

Since retirement from **W.R. Grace**, **Peter Rinaldo** in Scarborough, N.Y., has been actively writing articles and books. His ninth book, *Unnecessary Wars?*, will be published in October. . . . **Si Bessen** sends word from California that **Roz** and he are looking forward to our 50th Reunion and hopes that their health will permit them to see all their old friends again. **Si** hopes to retire later this year. . . . **Roger Freeman, Jr.** is still enjoying retirement years and staying active in his community. While his health is not great, he reports that he is still vertical. . . . **Ruth** and **John Johnson** are traveling to Botswana and Zimbabwe this October. This will be their third visit to southern Africa. In years past, they have been to Morocco, Egypt (twice), and East Africa (twice). He feels they have an affinity for Africa.

Herbert Cunningham retired from NACA/NASA after 40 years and moved to Peachtree City, Ga. He has two grandchildren so far. . . . The Society of Plastic Engineers at its 51st Annual Technical Conference in New Orleans, La., in May 1993, elected **John Hull** an "Honored Service Member" of the Society. **John** was one of 25 senior members to receive this honor. A member of the Society since 1955 and a senior member since 1967, **John** was one of the founders of the Plastics in Electrical Insulation Professional Activities Group, which later became the Electrical and Electronics Division. **John** held the offices of chairman, secretary, newsletter editor, and special projects chairman. He was active in the Division's participation in several regional technical conferences and presented technical papers at these and the annual conferences.

Reverend Robert L. Meier, author and Cape Cod minister, passed away at his home in Brewster, Mass., on June 14, after a long illness. After serving four years in the Army, he graduated from MIT in June 1947 with a degree in metallurgy and worked as a research engineer for United Aircraft Corp. in East Hartford and Oak Ridge, Tenn. A desire to do more for others led him to leave engineering and enter the ministry. He graduated from Hartford Theological Seminary in 1953 with a bachelor of divinity degree. He served students in West Granby and Copper Hill, Conn., before being called to Lordship Community Church in Stratford, Conn. In 1959 he was called as an associate minister at the First Church Christ Congregational in West Hartford, Conn., followed by a call to be the senior minister at Stanley Congregational Church in Chatham, N.J., in 1960. From 1965 to 1984 he served as senior minister at the Maple Street Congregational Church in Danvers, Mass., before being named minister emeritus. While in Danvers and at his other parishes, he strongly encouraged his congregations to reach out to serve the community of the world and to become involved in social issues such as race relations, the problems of youth, and the plight of the mentally ill. Since retiring to Brewster in 1984, **Rev. Bob** had remained active writing poems and a book about faith and hope in today's world, entitled *Journey on a Small Planet*. He is survived by his wife, **Dorothy**, a son, a daughter, four grandsons, a

brother, and a sister. A memorial service was held in the Federated Church in Hyannis on June 20 which your secretary (Lou) attended.

Bernard J. Duffy, Jr. passed away on October 26, 1992, at Shawnee Mission, Kans. He is survived by his wife, Martha. . . . **Edward M. Jones** passed away on January 26 in Cincinnati, Ohio. He is survived by a daughter. No further details are available at this time on these two classmates. We extend the sympathy of the class to the families of our three departed classmates.—Co-secretaries: **Andrew F. Corry**, P.O. Box 310, West Hyannisport, MA 02672; **Louis R. Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to: **Clinton S. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

46

Got an interesting letter from a class member not listed in our book, but who requested to be part of our '46 class. Actually, **Boni Philip Martinez** matriculated at Tech in June 1944 but was later placed in February 1946 and finally graduated in 1948. Boni retired from Du Pont (in Delaware) in 1978 at age 65. He has been paying tidy amounts for a goodly sum to the Alumni/ae Fund and hopes they will be credited to our class. We hope that will be done with alacrity!

Another short "hitch" came from one of our class with a VI "batch" and VII master. He is **Eugene J. Gehrig**. Eugene originally came from Evanston, Ill., about the same time as the V-12s, and the class lists him as going back there, perhaps working for the Illinois Institute of Technology ever since. He mentioned that he had been hospitalized for three years "with no contacts made for the duration." Eugene is another good one who has sent liberally to the Alumni/ae Fund.

Okay, so here's the double whammy for our "leader," **Ted Heuchling**. We were sent a notice by the Alumni/ae Association that the Massachusetts Society for the Prevention of Cruelty to Children (MSPCC) has elected Ted to its statewide board of directors. He's been with the MSPCC over a year and as usual is "embarking on an ambitious three-year 'Good Start' campaign, realizing that prevention makes so much sense. It's an exciting time to get involved." Then we get a write-up of Ted's three-and-a-half-month sea voyage from Honolulu to Australia, sent from a '48 buddy, **Ken Brock**, and written by **Karen Abel** in *The Cape Codder* May 7. I'll relate just enough to give you an idea what it was like. His voyage actually took place a year ago, but I'll reiterate for those who haven't been told. It started with a cassette tape given to him by his son Paul. That did it. His first move was a trip to the MIT Library! On the advice of Paul's teacher, Ted bought a 22-ton, 60-foot cutter-rigged ketch in Honolulu, where he repaired the craft and readied to start out in mid-April. He got his crew together with friends of his and Paul's. On time, they pulled off for the 6,000 nautical miles of ocean through Hawaii, Tahiti, Cook Islands, Niue, Va'Va'u, Tonga, Fiji, New Caledonia, and the coast of Australia. Paul put together an extensive medical kit, along with a sewing kit, spare motor parts, and scuba gear. Also on board was an Emer-

gency Position Indicating Radio Beacon (EPIRB), which could be deployed automatically should the boat capsize. A lifeline ran along the deck with a clipped harness donned by all the crew. Communication was facilitated by contact with the Marine Net and phone patch using their call numbers.

Ted summed up his ocean crossing by saying: "The stars were absolutely gorgeous and we could pick out planets rising in a clear sky. One night on the final leg to Australia, a huge school of dolphins fluoresced in the water at our bow. . . . There were times when it was just glorious, driving through the vast ocean with perfect wind and sunshine." Ah, Ted, is the boat still in Australia?

Just as I was putting this tome together, darned if I didn't get a short letter from one of our Navy/V12ers, **John Serrie**, an old ship-builder who has been living up in Tenants Harbor, Maine, for a while. He asked about the planned V-12 Reunion. So I got on the horn to call Clinton Springer, '45, who brought up the idea a year ago. Turns out Clinton, who lives in New Castle, N.H., not too far south of John, had difficulties getting support from the honchos in the building. It was very disappointing for those on board, including this dits.

That's about all there is to say in this story.—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

47

Unfortunately, too many of the items we have to report in this column are obituaries. This month, however, we are happy to report (for the first time since we've been writing the column) the *cancellation* of an obituary! To paraphrase Mark Twain, the reports of **Dick O'Donnell's** death were greatly exaggerated. Somehow his death was announced in his fraternity newsletter last spring. Dick is alive and well and enjoying life in Hilton Head, S.C. He does say that he and his wife have moved away from the beach in Hilton Head to a location where they don't have to worry about hurricanes, beach erosion, etc. This summer the O'Donnells plan to spend a month in Europe, culminating in a cruise from Copenhagen to St. Petersburg, Russia, via Helsinki. Nancy and Jack Hawkins, '49, will be with them on the cruise. (Coincidentally, Ann and I will be taking the same cruise from Helsinki to St. Petersburg in September.)

We have a brief note from **Bob Devine** in New York City. He worked for Timken Roller Bearing for seven years after graduation. He then moved to Wall Street because he felt the prospects of promotion to management for metallurgical engineers were rather slim in industry. He retired in 1984 after 35 years on "the Street."

Roy Oberholtzer writes that he's thoroughly enjoying his retirement. He's designing a model railroad layout using a CAD program. Last summer he and his wife drove to Alaska via the Alaska Highway and returned via the Alaska State Ferry—Skagway, Alaska, to Prince Rupert, British Columbia. That was a 9,200-mile trip in 40 days. Last January they took an MIT Alumni/ae Association cruise through the Panama Canal. Roy strongly recommends either or both trips! According to our Alumni/ae Directory, Roy is living in Cedar Rapids, Iowa.

Joseph Hobaica died in February. He spent 30 years with the Foxboro Co. and retired in 1976. He was also a professor in the evening division at Stonehill College, where he taught

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accounting. He was a member of the Stonehill Chapter of Beta Xi. In 1991, his students approved him as a member of the Beta Chapter of Alpha Sigma Lambda. He is survived by a brother, five nephews, two nieces, a grand-nephew and a grandniece.

Bob Horowitz died in March. He was president of Hancock Machine, Inc., in Wakefield, Mass., and was living in Newton, Mass. We have no other information. . . . We have also learned that Albert Openshaw died in 1991 in Amsterdam, N.Y. He is survived by his widow.—R.E. (Bob) McBride, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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Our 45th Reunion was enjoyed by all who came, and Milton Slade, our reunion chair, deserves much credit for the success of the reunion. His wife, Jean, was not only supportive, but she contributed several excellent suggestions and did a lot of work preparing gifts for the other spouses who attended. Milton's efforts were rewarded by the weatherman who cooperated for five days with the exception of a few hours on Tuesday morning.

Ken Brock organized a doubles tennis tournament. Irma and Herb Kurinsky, Harold Ottobri, Margie Welsh, Ann and Ken Brock, Norb Andres, Gloria Monosson, Paula and Irv Kagan, Anita Smith, and Herb Lipson participated. The all-day event was a fairly competitive senior match. The men hit the ball back and forth and the women put the ball in the right place. Gloria Monosson and Norb Andres won the event. Gloria used a drop shot with excellent placements and Norb has a sensational overhead smash. Ken put enough spin on the ball to constantly surprise his opponents.

My five-year term as president of our class has ended, and I am pleased by the support that I received to assist in achieving a successful term. We had a 43rd Reunion, annual champagne brunches at Endicott House, and attended an MIT football game. Our 45th Reunion was attended by 74 classmates (spouses increased attendance to over 130 people) who enjoyed the get-together from start to finish. The highlight for Gloria Monosson and George Clifford was bidding and making a seven no trump game in bridge. Everyone else had their own special period. I enjoyed the dancing on Tuesday evening.

George Clifford presented his committee's nominations for class officers at the class meeting. George, Sonny Monosson, and Peter Saint Germain served on the nominating committee. Denny McNear was nominated to be president. Harold Ottobri was nominated to be treasurer, and Marty Billett was (you guessed it) nominated to be secretary. No nominations were made from the floor, and Bob Crane moved to close the nominations and that the secretary be instructed to cast one vote for all candidates. In accepting his office, Denny commented that at the 50th Reunion our class will be invited to join the 1998 graduates in the ceremonies commemorating their graduation. Denny announced his plans to enlist classmates to serve on the committee to solicit our 50th Reunion Gift. He appointed Sonny Monosson, Graham Sterling, and George Clifford to begin planning the fun portion of the Reunion.

The current vice-presidents of our class were not replaced and will continue to serve while Denny lines up a team to plan and implement our 50th Reunion. Past presidents of our class continue to serve as class officers.

During the Class Meeting, Ken Brock reported on the results of our 45th Reunion Gift to MIT. Bob Sandman, our treasurer, reported that registration and event fees had been received, but the bills have not been received. Therefore we had a large balance, temporarily.

Bob and Charlotte took a photograph of everyone and we made a large poster with all the pictures. These pictures will be added to the scrapbook from the 35th Reunion prepared by Nancy and Jim Mason.

Attending a reunion for the first time were Marshall Baker, Don Rehkopf, Bascom Birmingham, Dave Leighton, Harrison Rowe, and John Bouzoucos Booth. During dinner Harrison Rowe explained that the opportunity to see Malcolm Reed for the first time in 45 years prompted him to come. Harrison retired from AT&T Bell Labs a while ago. Then he joined the faculty of Stevens Institute of Technology and is still teaching. . . . John Bouzoucos Booth spoke eloquently of his concern for our country and for MIT. John is active in real estate in Manhattan. He believes in a hands-on approach and attends planning board meetings when they discuss property he is developing. . . . Marshall Baker commented before speaking that John was a hard act to follow. Marshall had been with DuPont in Wilmington and was an active Educational Counselor for many years. He has a second home on the Cape and loves Nantucket. Later, Marshall led the singing of MIT songs while Jean Turkington played the music. . . . Don Rehkopf has retired from a teaching career. He missed prior reunions because he was busy making assignments and correcting term papers. . . . Dave Leighton attended MIT after graduation from the Naval Academy. His career in the Navy kept him busy until his retirement with the rank of Captain. . . . Bascom Birmingham has received numerous awards for his work in cryogenics. He wanted to see Nantucket although it is a long way from his home in Boulder, Colo. Bascom was able to maneuver his wheelchair all through the Nantucket Inn during our visit.

After dinner on Tuesday we recognized Bill Maley, Irving Kagan, Curtis Green, Bill Hosely, Bob Welsh, and other classmates for the service they provide their communities as directors of hospitals. I also commented that many classmates have been Educational Counselors for MIT although we have not seen them at class events.

After three beautiful days on Nantucket, we returned to MIT for a pre-Pops buffet on the 14th Floor of the Hyatt Regency with a superb view of the Charles River and entire Campus. Friends from the Class of '47 and '49 joined us for dinner. Professor Jacqueline Hewitt, physics, who holds the Class of '48 Endowed Chair, was also with us at all our meals on campus.

Friday evening we had dinner at the Faculty Club. Howard Johnson, chair emeritus of the MIT Corporation joined us. After dinner the class presented an MIT captain's chair to Milton Slade for his role in implementing the reunion. As outgoing president, I was given a set of MIT buttons to put on the Red Blazer we will wear at our 50th Reunion.

Jay Keyser spoke after dinner and his stories and photos of cows on top of the dorms and other hacks kept us smiling. He also pointed out that hacks at MIT have avoided hurting anyone and are mainly addressed at making fun of institutions. Jay is associate provost and holds the chair that Peter DeFlores endowed to bring a poet to MIT. Jay's first book of poetry will be published this year. Jay is a jazz trombonist and linguist.

Geraldine (Mar) Haughey attended the 45th Reunion with her son Tim. Gerry was a member of the American Society of Civil Engineers from sophomore to senior year. She also made Dean's List and belonged to the Chinese Students Club. She had two careers with public works departments and retired from San Jose after 16 years. Between careers she had six sons and three daughters.—**Marty Billett**, secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

49 45th Reunion

Four months ago (June), the first mailing (a questionnaire) by the 45th Reunion Committee reached all of you. We hope you have returned it. Any, or all, of the activities listed can be arranged and **Stan Margolin**, our man in Bermuda, will be a major influence in seeing that we have the time of our lives. Nobody, I say nobody, knows more about Bermuda than Stan does. One of the listed activities, scuba (sic) diving, got my attention. It is a new offering but promised to attract as many participants as golf (sic).

A heart-warming note from Vaughn Beals, '48, says: "Thought you might like to include in your column that Sid Howell's daughter, Wendy McCullen, just received her doctorate in veterinary medicine. They're proud parents indeed—as are Wendy's husband and her two sons." (Note: Vaughn Beals is chair/CEO of the Harley-Davidson Motor Co., Inc.)

Thomas J. Whitlow writes: "Since my wife is still working at Hughes Aircraft I have become the housemother (keeper), taking care of dishes, vacuuming, dusting, watering, laundry, etc. My true love is still tennis, which I play three or four times a week, plus competing in tournaments about once a month in the 75-to-80 age bracket. Once a week I participate in a Hughes-sponsored program at an East Los Angeles school helping demonstrate science to a class of 3- to 6-year-old students."

Rodolfo F. Barrera gives a tantalizingly brief list of his activities in a note dated May 5. They are: president of the board of directors of Dirona, S.A., and president of the board of directors of Fabrica De Tractores Agricolas, S.A. . . . **Ray Homan's** (Dewitt, N.Y.) note for the secretary reads: "Time has never been more filled than since retirement. Summits attained include Iceland's highest, Japan's Fuji-san and Hotaka, Nepal's Kala Patar, together with the Tour du Mont Blanc and New Zealand's South Island plus four grandchildren. My wife and I are busy!"

Donn Pennell (Lewistown, Mont.) says he is "semi-retired so that I do have some office hours—nearly daily. Am retired enough to have the classic place in the country with trees, horses, vintage cars, and good friends. Children are usually home for Christmas and July. All five are married and live from Boston to California."

Daniel W. Greenbaum is "stepping down from CEO/managing partner at Vollmer Associates (New York City) due to some health problems. Will continue less activity in projects for which I was formerly responsible, such as reconstruction of the Times Square subway station, reconstruction of the West Side Highway (successor to the infamous Westway project), expansion of U.S. Tennis Association's Open facilities in New York, and liaison for Vollmer Associates' work on the Third Harbor Tunnel/Central Artery in Boston."

According to a note from the Alumni/ae

Association, **John L. Eddy, Jr.**, and Mrs. Donald Young (widow of Donald, '50) stopped by to ask that their wedding announcement be published in the class notes. They will be married on September 26. It is a particular pleasure to report news like this.

My old buddy, **Jack Baker**, with whom I hustled dishes in Walker Memorial, has sent me enough material for the next 11 columns and it grieves me to say that not all of it will find a place here. Not that it wouldn't be interesting because all of it is. Jack says: "For the past 22 years I have been VP of Management Recruiters of Ann Arbor, Mich., recruiting and placing experienced engineers and scientists. I remarried in 1985 to Sue Baker after my first wife died in 1982 of lung cancer. Between us we have 10 children—6 of mine and 4 of hers, plus 7 children-in-law and 13 grandchildren. In 1992, Jack was relieved of his wallet by three baddies in the Paris Metro. Jack took off after the one with the wallet while Sue screamed "voleur!" (thief). The *voleur* threw the untouched wallet on the pavement and fled to avoid the crowd that was gathering."

Brass Rat Alert: The Review office has received a message from Burt Toma, '90, treasurer of the MIT Club of Hawaii, that a MIT ring of the class of '49 was found on a local beach on April 14, 1993. It had three initials: J or T, P, and F. If you think this is your ring, contact Sherrie Saint John at Tech Review: 617-253-8251.

According to a note from his wife, Joan, **Richard A. Cotton**, 65, died December 4, 1992. He was retired and living in Franconia, N.H. I deeply regret the absence of any further information.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Technology Day for 1993 has gone by and unfortunately your correspondent was involved in a family wedding in another state and couldn't participate. Since then, I was lucky to have lunch with Sue and Mal Green in June on Cape Cod and he reports that the class was well represented. **Bob Mann**, **Jon Granger**, **Bill Murphy**, and the Greens were in attendance. Mal reports that Jon Granger has retired but has not stopped working, and is now part of a nationwide group of experts involved in insurance matters. . . . Bill Murphy has taken a brand-new position as project director for the expansions that Tufts-New England Hospital is planning for Grafton and the South Cove in Boston. Good luck Bill. . . . Sue and Mal enjoyed a family reunion with all their children, in-laws, and especially their first grandson in Florida last winter.

Dr. James Goff has agreed to become editor of *Naidbeachd*, the journal of the Scottish Gaelic Society in America. He is interested in the language and its relation to other European languages. . . . **John L. Eddy**, '49, and Mrs. **Donald Young** (widow of Donald) will be married on September 26. Congratulations to them both.

Nat Cook writes from Cape Cod that Collie and he are retired (professor of mechanical engineering at MIT) and living happily on Cape Cod. His four children are married, three with degrees from MIT and the fourth from Harvard. They are proud grandparents seven times. He is happily involved in a Boston-based instrument company. They enjoy boating, gardening, travel, and life in general.

Karol Stark is still active with Stark Industry—selling manufactured components (machine parts) to industrial accounts in the USA. His last son is a freshman in high school. Karol will move to a retirement home at Lake of the Woods, Va., in three years. . . . **Francis Hogan** retired as an actuary and pensions officer at the International Monetary Fund in 1992. When the weather is moderate (although he intends to remain in Potomac, Md.), he plans to spend time in Moody Beach, Maine.

It is with sadness that I report the death of **Allan Shaw** of Course XVI. He passed away in May at Arlington, Tex. He had worked for LTV Corp. since graduation. Our condolences to his wife, Mary Elizabeth, and his two children. . . . Keep the news coming.—**John T. McKenna**, secretary, P.O. Box 146, Cummaquid, MA 02637

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At the 40th Reunion our class established the '51 Fund for Excellence in Education. The purpose of the fund is to enhance the undergraduate educational experience at MIT, and our class has supported it with pledges of \$750,000. A small group of classmates have developed a specific arrangement with the Institute to get this program under way. An agreement has been concluded and we expect to see the first activities started early next year. Under this program, proposals would be solicited from the faculty and teaching staff to conduct projects such as the development of new curricula, training programs to enhance teaching skills, development of innovative teaching techniques and teaching aids, and teaching evaluation methods. A committee, chaired by the dean of Undergraduate Education (currently Dean Arthur Smith) and consisting of representatives of the deans of the schools and our class, would annually select and make awards from our class fund to support one or more of these projects. These projects will be continually reviewed and their progress and achievements made known to our class. Through your foresight and generosity, we should see the start of this exciting and innovative program by early next year. We are anticipating a great deal of interest and will endeavor to keep you informed. We hope you will continue your interest and support for our fund.

Having set himself for retirement in Scotland's Orkney Islands, **Ray Gruwell** has been lured back into the position of deputy project director for a billion-dollar-plus plant for ADNOC in Abu Dhabi being built by a Bechtel/Technip joint venture. He finds it rewarding to finish his career with a big one. . . . Except for a three-year break to obtain his doctorate at Columbia University, **Russell B. Hodgdon** has been practicing chemical science since 1951. He now plans to call it quits on his 69th birthday next November. As the first venture into retirement, he and his wife, Doris, will go on a 20-day trip to the Falkland Islands, South Georgia, and Antarctica. This should tune them for the rigors of retirement living in Harwich on Cape Cod.

After 30 years in the Boston area, **Robert C. Lewis**, now a retired Air Force Lt. col. (chaplain), and wife Loetta have moved to Sun City Center, Fla., and are devoting much time to church work and square dancing. . . . The Navigation Presentation at the Marion-Bermuda Race Seminar held at MIT this year was given by **Jerry Marcus**. Jerry is more than a sailing enthusiast. He has become a noted authority.

He introduced an original treatise, "Optimizing Ocean Current Crossings," that will be published shortly by the United States Sailing Association. The treatise will be of special interest to Bermuda Race navigators and other deep-ocean sailors crossing major currents.

As a final but sad closing note, we have been informed of the passing of **Karl Kniel** in March. Karl lived in Rockville, Md.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

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Steve Spacil is among those interested in the proposed Far East mini-reunion next year. He notes that he has been to a lot of the places on the tour already—Kuala Lumpur, Bangkok, Hong Kong—for business or pleasure, but has no aversion to another visit to these places, as well as visiting new ones. Steve is still working at GE's R&D center in Schenectady, N.Y., but is trying to arrange a slightly early retirement, perhaps this year. His plan is to move to St Croix, Virgin Islands, where he has built a house, and return to teaching, at least part time, in the Virgin Islands or Puerto Rico.

Steve congratulated me for publishing my e-mail address. "Among other things," he says, "it shows that the older generation is capable of learning a few new tricks." Older generation? Us? Oh!

Well, if you are not too old to travel, and are interested, along with Steve, in the mini-reunion, please let me or any other class officer know about it.—**Richard F. Lacey**, secretary, 2340 Cowper Street, Palo Alto, CA 94301; e-mail: lacey@hpl.hp.com

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I am writing these notes just two weeks following our 40th class reunion. Seventy-three classmates reunited at MIT for the June 2-4 festivities and many of these continued the celebration from June 4-6 at Chatham Bars Inn. (Attendees came from 21 states; while 39 percent came from New England, an amazing 14 percent came from California.)

On campus we began with a reception hosted by President Vest, followed by a dinner/dance at Walker Memorial; Chair of the Corporation Paul Gray, '54, and Provost Mark Wrighton were honored guests at dinner. On Thursday, dinner at the Hyatt was followed by Tech Night at Pops, the latter being marred only by the "politically correct" version of "Arise Ye Sons of MIT." At Friday's Technology Day lunch, **Dick Simmons** (our reunion gift chairman) announced our \$6.7 million 40th year Reunion Gift, a new record. Then, 33 members of the class and their spouses motored to Cape Cod. There, old friendships were rekindled and new ones begun. Both were reinforced by the weather, the charm, good service and food, and friendly surroundings. The Friday evening cocktail party and lobster (and steak if you asked for it) dinner were scrumptious. Afterwards, the slide presentation of the class questionnaire results was greeted with hoots and laughter, while both the presenter and audience claimed victory. Saturday was a lazy day for a long, leisurely (and magnificent buffet or special order) breakfast while we all swapped lies and tales, a trip to the outer bar (where Peggy and Ben Coe rescued a hopelessly entangled sea gull), a round of golf, etc., and then a marvelous cock-

tail party and dinner. The last was topped off by an announcement of class officer election results; rumor has it that some tried to switch votes by buying drinks. But our non-partisan Chairman of Vote Counting **Sid Hess** attested to the results: **Fred Brecher**, president; **Dick Linde**, treasurer; and (sigh!) **Marty Wohl**, secretary. (If you don't like the results, vote early and often the next time.) Finally, another splendid and talkative breakfast on Sunday morning before, once again, we had to return to reality. It was both pleasant and sad.

Before I close, one more thing. On behalf of all classmates, let me thank our officers of the last five years: **Gil Gardner** for his terrific service as class secretary; **Dick Lindstrom** for his yeomanly work as vice-president and local "handholder" during reunion planning; **Dick Linde** for outstanding assistance as treasurer; **Dave Berg** for his important help as reunion co-chairman; **Dick Simmons** for tackling the impossible task of reunion gift chairman and for his generosity; **Jack Stewart** for his significant help in organizing activities on the Cape; and **Fred Brecher** for agreeing to put together our 40th Yearbook.—**Martin Wohl**, secretary, 4800 Randolph Dr., Annandale, VA 22003, (703) 354-1747

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40th Reunion

Don't ignore the correspondence from **Bob Warshawer**—our 40th Reunion is approaching very quickly. Send Bob your notice of intention to attend or not and your \$40 class dues, if you haven't already done so. And save the dates: June 1-6, 1994. All indications are that it will be a great party.

A welcome letter from **Bill Eccles** informs us that he has been having fun living the gypsy life since retiring from the University of South Carolina three years ago. He and Trish spent two years at Rose-Hulman Institute of Technology in Terre Haute, Ind., and last year at Oklahoma State University. This academic year they are back at Rose-Hulman where Bill has accepted a tenure-track position; it was a short retirement, apparently. In the meantime, he and Trish did all the sights in Oklahoma and the nearby part of Texas, and really enjoyed that "different" section of the country.

We have received word that **Bill Ferrini** died in Rome last April. After his military service, some study at the University of Rome, and a few years working in Boston, Bill lived in Puerto Rico briefly before returning to Rome. There, he and his wife founded the architectural firm **Ferrini-Valle & Associates**. Our sincere sympathy goes to his wife **Enrica** and their two sons. . . . Drop me a line about your latest activities—and plan now for the reunion next June.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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George Rubissow, Course VIII, writes us from Paris, France, that his attempt to grow the best red Bordeaux-style wine in the Napa Valley is gathering momentum. He explains that the expression "to grow" wine is correct, according to practice—conjuring visions of wine bottles hanging enticingly on the vines of their hillside vineyard, overlooking diminishing hills below that fuse into the San Francisco Bay in the distance. After being in the market, under the name of "Rubissow-Sargent" for just over

a year, they are *starting* to become available in stores and restaurants from California to New York—including Boston and environs, such as the Chanticleer Rest in Nantucket. George notes that he met his partner, **Tony Sargent**, because at Berkeley he once turned to George to design an electric fence for Tony's pet coyote. Both of them (**Tony** and **George**; not the coyote) are PhDs in biophysics; amazing how far one can go in biophysics—from coyotes to wine! Aside from Napa and wine, **George** spends most of his time in Europe in industrial development and marketing—as well as studying Bordeaux wine-growing practices. He has done extensive sales work in Russia for heavy foundry equipment with such customers as the Vaz automobile works on the Volga River (manufacturers of Russia's popular small car, the Lada). Currently, he is working on new projects in Germany, France, Switzerland, and the United States. He looks forward to seeing classmates either at his vineyard in Napa, his winery in Berkeley, or at our 40th Reunion.

An announcement from **Thiokol Corp.** tells us that **Joseph Lombardo**, Course IX-B, has been named as general manager of its Space



Joseph Lombardo

Operations. He has been a vice-president of Thiokol since October 1991, with responsibilities encompassing the overall management of Space Operations, including top-level interface with NASA officials. Dr. Lombardo joined Thiokol in 1989 from the NASA Marshall Space Flight Center, Huntsville, Ala., where he had managed the Space Shuttle Main Engine Projects Office. He has served with NASA for 32 years, establishing a highly successful record as a nationally recognized propulsion expert and demonstrated excellence as a NASA project manager. Joseph did graduate studies at Rensselaer Polytechnic Institute and holds a doctorate in industrial and systems engineering from the University of Alabama in Huntsville.

Murray Gerber, Course II, president and founder of Prototype and Plastic Mold Company, Inc. in Middletown, Conn., has been appointed to the Mid-State Advisory Board of Fleet Bank N.A. **Murray** lives in West Hartford and earned an MBA from the University of New Haven, after getting his mechanical engineering degree from MIT.

And what about the rest of you? Surely you have something interesting to tell your classmates!—Co-secretaries: **Roy M. Salzman**, 4715 Franklin Street., Bethesda, MD 20814; **James H. Eacker**, 3619 Folly Quarter Road, Ellicott City, MD 21042

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Charles H. Kruger of Stanford, Calif., was appointed vice provost, dean of research and graduate policy at Stanford University on January 1. . . . **Allan C. Schell** of Beavercreek, Ohio, remarried during 1992. He has moved to Ohio to the headquarters of the recently formed Air Force Material Command. **Allan** is the deputy director for science and technology and continues as the chief scientist of the Command. **Allan** and his wife, **Shirley**, are enjoying Ohio as a change after the last five

years in Washington, D.C.

I would like to report that I enjoyed Technology Day and had a chance to speak with several members of our Class. The following classmates were registered: Lloyd Beckett, John Dorsey, Bill Dickson, Margy Gilson, Dick Jacobs, Ron Massa, Bill Northfield, William Oakes, Gordon Sammis, Rolf Wetzell, and Dexter Wheeler.

Dick Jacobs became the 99th president of the Alumni/ae Association. Dick also joins the Corporation as an ex officio member. He received an MBA from Roosevelt University in 1979. Since 1992 he has had his own consulting firm in Northbrook, Ill. He also serves as counsel/senior vice-president of A.T. Kearney, Inc., global management consultants. In his association with A.T. Kearney, which began in 1966, Dick has held a number of management positions with the firm. He has also been associated with Mobil Chemical and Champion International and was a vice-president of Questor Corp. Dick's wife, Nancy, and daughter Alison were at the dinner in Dick's honor where he gave his acceptance speech as president.

Gordon Sammis reports that he has the position of principal engineer in operations analysis at Grumman Aircraft Co., Long Island, N.Y. He has three daughters, two of whom are married, and he is soon to become a grandfather.

I am sorry to report that William J. Alston III, of Ipswich, Mass., died in March. Alston was a physics teacher at Hamilton-Wenham Regional High School. He received a master's and doctorate from Yale University in 1965. He was associated over the years with Boston University, Market School and Renaissance School in Washington, D.C., and Wentworth Institute of Technology in Boston.

Send news to: Ralph A. Kohl, co-secretary, 54 Bound Brook Rd., Newton, MA 02161

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Please send news for this column to: John Christian, secretary, 23 Fredana Rd., Waban, MA 02168

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Our 35th Reunion was indeed a real nice clam-bake! Both the accommodations and the dining at the Black Point Inn were delightful. Nearly everyone hiked along the nature trail by the ocean, many sailed, some shopped at L.L. Bean, and a large group visited Winslow Homer's studio where Doris Homer, a relative now in her 80s, gave a talk. Our total of 155 attendees—83 classmates and 72 guests—exceeded MIT's projections by 25 percent and was greater than any class except the 25th and 50th. Many classmates have been "regulars" at our reunions where, just like *Cheers*, nearly "everybody knows your name." But we were pleased to welcome many new faces this year, and they've all said they'll be back for the 40th.

Our 35th Reunion Committee, chaired by Cole Bess, did an outstanding job as evidenced by the turnout. Judy Bess, Cole's wife, was among several spouses who were active members of the committee, much to its benefit. Selection of the site was handled by Anne and Roy Scarpato, Milt Jones, and Gary Fallick. Our reunion treasurer, Dick Rosenthal, smoothly coordinated the finances. Working on other tasks were: reunion souvenir—Gary Fallick; activities—Liz Drake; band/music—Beth and Al Russell, Muriel and Milt Jones, and Nancy and Mike Brose; publicity—Judy and Cole Bess, Bonnie and Stan Klein. Coordination of the 35th Class Gift was and continues to be chaired by Marty O'Donnell with more than a little interest from Glen Strehle.

Al Russell created the off-the-wall questionnaire and presented the results in a "Saturday Night Live" routine at the Inn (sample: "The average Course numbers for those responding was 8.2."). Al awarded prizes (you had to be present to win) for such categories as: Greatest Distance Traveled to Reunion—Eddie Changkasiri and his wife, Somwong; Youngest Child—Tanja and Steve Dorsey; Oldest Grandchild—Phyllis and Jack Raymond; Most Mentions in the *New York Times* or *Wall Street Journal*—Rex Ball; Most Books Published—Bob Baber; Most RAM on their PC—Conrad Revak (24 MB); and Biggest Slide Rule Carried on Their Person at the Reunion—Frank Henrick.

Cole Bess presented special certificates of appreciation to the regional coordinators who contacted classmates in their area by phone. They included: Bill Bayer, Dale Dukes, John Boynton, Mary Ann McLaughlin, Toni Schuman, Pete Hellsten, Jack Raymond, Charles Braun, Bob Jones, Herb Johnson, Phil Friend, Ed Lee, Sheldon Dean, Al

Phillips, Dick Shaffer, Ed Sullivan, Harry Weintrob, Ernest Fleming, Matt Smith, Mike Sudol, Gus Fleischer, Sandy Nobel, Sars McNulty, Steve Friedman, Ken Auer, and Paul Rothschild. We heard from several of those contacted who said they really appreciated receiving the call from a classmate even though they might not be able to attend the reunion.

At this reunion we enjoyed the participation of a number of MIT staff and faculty. On Thursday before Tech Night at the Pops, we held a seminar on the topic of "Psychological Issues of Retirement," chaired by Dr. Peter Reich, head of MIT Psychiatry. Attended by about 40 classmates and spouses, it was a very open and participative meeting that everyone found very enlightening. At Friday dinner at the Black Point Inn, Evan Ziporyn, the Class of 1958 Professor, played one of his compositions for clarinet combining Far Eastern, African, and American jazz themes. He delighted us not only with his music, but with his humor and quick wit. Also attending the reunion as our guests were Danny Watt of the MIT Alumni Office, and his wife, Ruth. An expert photographer, Danny joined Beth Russell in capturing all the attendees on film. And, throughout the planning process, the committee had wonderful support from Amy Souza and Eliza Dame of the Alumni/ae Office staff, who cheerfully made our reunion wishes come true. Thanks to you all from the committee and the class.

Well, campers, that wraps up our coverage of the 35th Reunion. We're already looking forward to the 40th!—Mike Brose, secretary, 75 Swarthmore St., Hamden, CT 06517

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35th Reunion

At the top of my notes mail is definitive information from Jack Fischer on our 35th Reunion, now less than a year away. Here's the scoop from Jack:

"I am pleased to provide this reunion update for *Technology Review*. After visiting potential sites all over New England, your reunion committee has selected the Black Point Inn in Prouts Neck, Maine as the site of our 35th Reunion to be held June 2-5, 1994.

"The Black Point Inn is just two hours north of Boston, and is also accessible from the Portland Jetport about 10 minutes away. It is one of America's few remaining resort inns and its unpretentious elegance has been recognized the world over. It is situated on a cliff high atop the beach and offers stunning vistas of the rocky Atlantic coastline. We've reserved 60 of the choicest rooms and suites, most of which offer dramatic ocean views.

"Black Point offers a wide variety of things to see and do. Boat trips and sightseeing tours may be arranged in Portland's Old Port District. L.L. Bean is just north in Freeport, to which we plan to arrange a group visit and tour (it is open around the clock!). The largest collection of Winslow Homer paintings is on display at the Portland Museum of Art, and Homer's studio is within walking distance of the inn. In addition, bikes are available at the inn and sailing can be arranged aboard the inn's private yacht. We will also have access to the adjacent 18-hole golf course and to 14 clay and all-weather tennis courts.

"I think that all who attended our 30th Reunion at Ocean Edge in Brewster would agree that it was one of our best ever. Let's build on that success and not only reaffirm our ties to the Institute but renew old friendships and begin some new ones.

"Your reunion committee, consisting of



Al Russell, right, congratulates classmate Frank Henrick on his award-winning "Longest Slide Rule" at the Class of 1958's 35th Reunion at the Black Point Inn in Maine. Awards were presented, but photos are not available, of "Youngest Child" and "Oldest Grandchild" honorees.

Ginny and Dave Packer, Anne and Larry Bishoff, Carol and Ed Vrablik, Mary and Glenn Zeiders, Sheila and Bill Widnall, Al Kniazze, Chuck Staples, Dick Sampson, Art Collias, Alan Bufferd, Mel Platt, and Margaret and Jack Fischer promise to leave no stone unturned in making sure that your return to Tech and visit to the Maine Coast is a truly memorable one.

"So please set aside June 2-5, 1994 on your calendar now and plan to take part in all the Reunion events, including Tech Night at the Pops (Thursday), Technology Day (Friday) and three fun-filled days at the Black Point. We'll be following up with a class dues mailing and complete schedule of events in the coming months. All of us on the Reunion Committee look forward to providing a warm reception no matter what the weather next June in Prouts Neck!! Finally, send us any and all ideas for the Reunion, as we are now into the real planning. Sincerely, Jack."

A recent bit of good news is that Art Collias has agreed to chair the 35th Reunion Class Gift effort. You will be hearing more from him shortly regarding this important initiative.

Coincidentally, kudos to Jack Fischer, not only for his work for our Class, but also for receiving the Stahl Community Service Award, which honors the memory of the man for whom service to the Jewish community was a way of life, presented in June at the Jewish Community Center of the North Shore in Marblehead, Mass., reflecting Jack's extensive involvement in a plethora of community and national activities. Jack is a financial consultant and director of Copley Controls Corp. in Westwood, Mass., and he and spouse, Margaret, live in Swampscott and have three grown children, Janet, Samuel, and Douglas.

A note from Gerald Schroeder informs us that he lives in Jerusalem with spouse, Barbara, and "five kids, ages 9-17, two boys and three girls." The Schroeders are both writers. Gerald wrote a book on science and the first chapter of Genesis, entitled *Genesis and the Big Bang* and published by Bantam, now in five languages. Barbara writes for magazines: *Parents*, *Woman's Day*, etc. Keep an eye out for their work!

More honors, this time to Michael Intriligator, included in the latest *Who's Who in America* for his contributions as an economist and educator. Mike is a professor at UCLA, and his numerous publications and activities provide an impressive list.

A note from Seymour Rubenstein lets us know that after operating his own consulting company for the past two years he has joined McDonnell Douglas as vice-president for manned space in Huntington Beach, Calif.

The '59 table at the this year's Technology Day was populated by Bob Muh (who completed his term heading the Alumni/ae Association) his daughter, an MIT undergraduate, Al Kniazze, Dick Sampson, Chuck Staples, and Jack Fischer, as well as yours truly. An excellent program, and, as always, an enjoyable time with a some classmates.

That's all for now. Again, I urge you to *actually do it*—send an update, which will be much appreciated by your classmates!—Dave Packer, president, 31 The Great Road, Bedford, MA 01730, (617)-275-4056

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From Bern, Switzerland, I received a postcard from Andrew "Drew" Larsen, who was visiting the Albert Einstein house—a flat he occupied during his years working in the Bern

Patent office. (Having just read MIT physicist and writer Alan Lightman's book, *Einstein's Dreams*, I especially enjoyed Drew's card. Incidentally, I highly recommend the book.) Drew writes that there were pictures of Einstein and Neils Bohr on the wall, reminding him of the Bohr's lecture series given during our time at Tech (freshman year, I believe). Drew assisted Professor and Mrs. Bohr during their visit to Tech, an experience he says he will never forget.

Inside the MIT beaver suit is one of our own, Bill Blatchley, a project manager for Camp Dresser and McKee working on chemical and environmental projects. I had a pleasant chat



Bill Blatchley

were mainstays of the MIT Club of Boston's silent auction to benefit the MIT Council on Primary and Secondary Education.

Gerald Hornik writes that in January he "returned to MIT, where I am director of technical services for the Media Laboratory."

... David Svahn's note says that he is still at Bassett Hospital in Cooperstown, N.Y. David's son, Jonathan, is following in both dad's and sister Noel's footsteps when he joins this year's entering class at Columbia Medical School.

A recent news release from DNS Associates in Burlington, Mass., announces that Ralph Cuomo has joined the firm as business development manager. Ralph, who also has an



Ralph Cuomo

MBA from Harvard, was most recently the electronic data interchange (EDI) manager for Norton Co. At DNS, Ralph will be responsible for building DNS's unique EDI services and products.

Lehigh University has honored Joseph Goldstein, professor of material science and engineering, with the Libsch Research Award for outstanding achievement and distinction in research.

Joe's research specializes in electron microscopy and its application to meteorites and diffusion-controlled transformations. From 1969 to

1980, Joe was a principal investigator in NASA's Lunar Sample Program, where he performed research on lunar samples returned from the Apollo flights. Joe and his wife, Barbara, have two children. Congratulations!

From Richmond, Calif., David Willis writes that he is completing his thirty-third year with Chevron. He is currently a consultant on energy management, water treating and conservation to the eight domestic Chevron refineries. Four of five children have completed college, and daughter Eileen is in her final year at Wellesley. The Willises also have two grandchildren. David says he's looking forward to doing independent consulting in about five years.

Having left McDonnell Douglas in Long Beach, Calif., Vernon Yoshioka writes that he is looking for another challenging position. In addition to a career in aerospace engineering, Vernon has been very active in civic affairs in San Diego, where he has, among other activities, been a candidate for the State Assembly, served as chair of San Diego's Noise Abatement and Control Board, and founded a human-care service agency.

Kudos again to classmate and MIT professor Sheila Widnall. At the 1993 commencement of Lafayette College in Easton, Pa., Sheila was awarded an honorary degree for her outstanding achievements in aeronautics education. The Lafayette announcement noted Sheila's many achievements, awards, and honorary degrees—too numerous to catalogue here. Our best wishes to you, Sheila, for continued success.

It is with sadness that I report the death of Gerard Cugini on April 25. Gerard was a self-employed architect in Bellingham, Mass. He is survived by his father, son, and daughter.

Finally, I want to thank all for the outstanding support of the 1992-93 Alumni/ae Fund. I hope I can count on you again this fund year. Also, and as I mentioned to all to whom I talked during my June mini-telethon, please pen a few words for the class notes when you send in your contributions.—Frank A. Tapparo, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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My friend Charlie Ruttenberg died of colon cancer early last May. His brother, Jim, who was in the class of 1963, wrote that the tumor was diagnosed the previous November but had metastasized to the liver by the time it was discovered. Charlie had felt tired and weak after his daughter Judy's wedding last August but didn't do anything about it until November. He was senior counsel to the chair of the National Labor Relations Board in Washington. Charlie was well educated. He had the MIT bachelor's (Course XXI), a PhD in government from NYU, and a law degree from American University. Charlie was a kind soul. He loved music and his religion, and always retained great pride in having made it though the Institute. I am sorry he died. So were many of his friends around the country. We sent our deepest condolences to his wife, Rhoda, his two girls, Judy and Miriam, his parents, Harold and Katherine, and to his sister, Ellen.

Max Keck wrote a nice letter the other day. It was to tell us that the Kecks had moved again, this time to Cincinnati from Kansas City. Max had been at Rockhurst College in KC. The move was prompted by his appointment as dean of the College of Arts and Sciences at Xavier University. Wow!! He had taken the job back in August 1992 but the family

couldn't move until their house in KC was sold. That took until November. In December Max traveled around the Far East to work out exchange agreements with Jesuit universities in Japan and Korea. He says that he is still teaching physics from time to time in some new facilities at Xavier. The Keck kids have fled the nest with Linda at law school in Illinois and Paul a sophomore in EE at Marquette.

Martin Falxa wrote a two-page letter for which I'm deeply appreciative. It's too bad there isn't enough space here to give it its due. The two pages were needed to describe his two careers. During his first career Martin took the guise of a chemical engineer and chemist. He got a PhD at Brooklyn Poly and had an NIH fellowship at Harvard Medical School. There followed a long career at Kendall Co. and Polaroid, where he was product manager for several new films. Then he went back to school, got an MS in computer science, and started a company, Jefferson Systems Development, which provides computerized accounting systems and other management tools to retail stores, wholesalers, and manufacturers. For the last few years Martin and his wife, Betty, have led wildflower tours in the Big Horns, the Tetons, and the Beartooths; all big mountain ranges in the northern mountain states. The Falxas have three kids ranging from 7th to 12th grade. Finally, the family loves orienteering, a sport in which you get lost, get handed a map and compass, and are wished the best of luck. Martin sent a magnificent map of a orienteering site on Peabody, Mass., made with a CAD package. Very impressive!

Last January the Boston *Banker & Trader* carried a picture of **Reed Freeman** and several of his fellow incorporators at the Hyde Park (Mass.) Savings Bank. The accompanying article noted that Reed is VP and manager of specialty chemicals at Union Carbide, where he has been since 1961! That must be unique in the class. One company since graduation! . . . **Dave Latham** wrote that, to their own surprise, the Lathams moved from Concord, Mass., to Harvard, Mass., last spring. By a perverse sort of logic they decided to get a bigger house now that their children had moved out! They now live in a 200-year-old house sited on some active agricultural land. "Does anyone know how to farm?" he asks. David continues working at Harvard's Smithsonian Lab in Cambridge, so his commute just increased by 20 miles.

Wes Hilton wrote that he is still going strong after five years as an independent consultant in computers, "of course." His children have left the nest: a son at University of Redlands in California; a daughter at RPI. . . . **Harold Meyer** reports that he is at "Hamilton Standard Division of United Technologies, doing research in aeroacoustics under a NASA contract. My wife, Judith, does computer work at Travelers Insurance. My oldest son is a junior at Oberlin College, the middle one is a freshman at Yale and the youngest is a sophomore in high school."

Navy Paragraph: **Ed Whitman** wrote that for the last three years he has been deputy assistant secretary of the Navy Department, but since the Clinton inauguration he has been acting as assistant secretary, pending a political appointment. How frustrating!! Ed reports that his oldest daughter, Leslie, graduated from MIT in 1988 (Course XV). . . . **Millard Firebaugh** came up with his yearly missive. He works for the Navy, too. He is chief engineer of the Naval Sea Systems Command. That means he is responsible for ship design and system engineering for the Navy! A big job! The Firebaugh kids are well onto their careers.

Joshua graduated from Rice in architecture last year, while Samara is a sophomore in EE at Princeton. Wife, Barbara, armed with a MAT from Gallaudet College, is teaching the hearing impaired in Fairfax, Va. . . . **Fred Schmitt** writes that he is an earlier retiree from the Navy. He accepted a buyout and left in September. He says he will go surfing on his old long board! Good luck, old timer!

John Savage tried to get me by e-mail last month but, because of a misprint in *Technology Review*, he couldn't find me. I am hoping the address below is correct. He gave up and used "snail-mail." The message was that he is now on the visiting committee for the MIT Electrical Engineering Department and that he has stepped down as head of EE at Brown after six years. . . . **Joe Harrington** wrote that after a reorganization over at New England Electric System he is now director of R&D on the wholesale business side. If that were not enough, he will stay on as VP of New England Power, where he directs four nuclear power plants. After work he is moderator of the Westborough town meeting. Joe's boys are finishing up their schooling. Joe, Jr., is in planetary sciences at the "Tute while Rob is in a biomedical program at Worcester Polytechnic Institute.—**Andrew Braun**, secretary, 464 Heath Street, Chestnut Hill, Massachusetts 02167 or via Internet: andrewb820@aol.com.

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Lloyd Armstrong, Jr., professor of physics and dean of the School of Arts and Sciences at Johns Hopkins University, assumed his new duties as provost and senior VP for academic affairs at the University of Southern California on August 1. He will serve as USC's chief academic officer and principal deputy to the president. USC President Steven B. Sample credited Lloyd as being "deeply committed to academic quality, both in research and teaching. At Johns Hopkins, he [Lloyd] was extraordinarily successful in finding ways to make the resources of a great research university available to undergraduates." Lloyd joined the Johns Hopkins faculty in 1968 as a research associate, became assistant professor of physics in 1969, associate professor in 1973, and professor in 1977. He was appointed chair of the department of physics and astronomy in 1985, and served as dean of the School of Arts and Sciences from 1987–1993. He is the author or co-author of six books and more than 68 journal articles in the field of atomic physics. Lloyd passed on the word about this appointment via e-mail in April, so if this information gives you a sense of déjà vu, you did get the earlier word without the details available in the USC news release.

Don Horner sent us an e-mail message from the Environmental Research Institute of Michigan (ERIM), where he serves as research manager. Don is in charge of Electronic Packaging Technology (i.e., multi-chip modules). He also sent greetings from fellow classmates **Roger Sullivan** and **Jack Walker**, who also work at ERIM.

Robert E. Anderson has been named chair of Genrad, Inc., of Concord, Mass., and the company has named James F. Lyons as the new president and CEO. Bob served as president and CEO from 1988–1993, and after significant restructuring and downsizing, has announced two profitable quarters and an expectation of profitability in 1993. Genrad manufactures computer-controlled test and measurement systems and this year is shipping

against the largest two orders ever received: a contract from the U. S. Marine Corps for digital test subsystems, and a major order from Ford of Europe for automotive electronics diagnostic testers.

John Rollwagen has withdrawn his nomination by President Clinton to be deputy secretary of commerce.

Scott L. Danielson dropped us a line from Burlingame, Calif., where he serves as technical director of architecture for Parsons Brinckerhoff, a leading firm in transit systems design and construction. Scott has worked on over 400 transit projects since his experience with Project Metro in 1966. These projects have included the conceptual design of the Taipei Transit System, 16 stations for the Singapore Transit System, high-speed rail in Korea (Seoul to Pusan), and feasibility studies for 27 stations in Jakarta, Indonesia.

Harold M. Waller was recently promoted to professor of political science at McGill University in Montreal, Quebec, where he also serves as associate dean of arts.

Ran into classmate **Philip H. Nelson** at Technology Day on June 4. Phil serves as a geophysicist with the U.S. Geological Survey in Denver, Colo. We had a short visit and compared notes about our long hours spent working in the historical geology lab in 1959–60 creating geological maps of the world for each geological time period from Precambrian to Pleistocene. We've both aged a bit since those days, but have continued to work in our chosen fields of geology and geophysics.

Received the obituary on **Jim Ross** from **Charlie Weller**, as well as another notice from the MIT Alumni/ae office on Jim's passing. James A. Ross served as a mathematician and senior science advisor at the National Security Agency. He died of cancer on Sunday, March 21, at his home in Silver Spring, Md. Prior to joining NSA in 1982, Jim worked at the Institute for Defense Analysis at Mitre Corp. He belonged to Shaare Tefila Congregation and was a member of the Shaare Tefila Choir. He was also active in the Sierra Club. Jim is survived by his wife, Elaine, two daughters, Amy and Melissa, of Silver Spring; his parents, Charles and Frances Ross of Drexel Hill, Pa., and a brother, John, of Tokyo, Japan.

Please write when you can to: **Hank McCarl**, secretary, P. O. Box 352, Birmingham, AL 35201-0352

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Sixty-six of us and about an equal number of family, significant others, etc., attended our 30th Reunion last June, and by Technology Day, 303 of us had contributed \$572,889 to the Class of '63 Reunion Gift. Thanks to many, led by **Robert Johnson**, our reunion gift chairman, we exceeded our half-million-dollar goal. There was a changing of the guard on T-Day. At dinner in the Hull Room at the Charlestown Navy Yard, our class elected **Larry Krakauer**, president; **Alan Bell**, vice-president; **Paul Abramson, Jr.**, vice-president; **Dan Ross**, class agent; and myself, **Shoel Cohen**, secretary. **Steven Bernstein** remains our treasurer. Thanks for a job well done by outgoing President **Peter Van Aken**, Vice-President **Kenneth Andersen** (who apparently only could be replaced by two people), Class Agent **Martin Schrage**, and Secretary **Phil Marcus**. Phil wrote this column for 10 years, and with his promise of help, I hope I can approach the great job he did.

Now for alum news (is that Latin: alumni,

alumnae, alum news?). **Patricia Sherman** and her architectural firm, Sherman Greiner Halle, were featured in a major news article describing their innovations in doing business with the community in a changing economic and regulated environment. . . . **Groves E. Herrick** received an Outstanding Faculty Member Award at the Maine Maritime Academy where he is professor of engineering. . . . **Frank Levy** joined MIT's Department of Urban Studies and Planning this year and became its first Daniel Rose Professor of Urban Economics. . . . **Steve Ditmeyer**, chief research and development engineer for Burlington Northern Railroad, won the Association of American Railroads' award for outstanding technological achievement for co-developing a natural-gas-fueled locomotive (better for the environment). He designated the award to MIT's Center for Transportation Studies. . . . **Kenneth Millett**, a professor of mathematics at UC/Santa Barbara, is president of a coalition for better math and science teaching from kindergarten through university.

Mike Sheriff writes that he is enjoying a second career as general counsel of World Vision, International, a humanitarian relief agency working in 90 countries. . . . **James Tang** started a new company, Transworld Mortgage Corp., serving \$7 billion in home mortgages. His son, Andrew, now 17, wants to be tennis next Michael Chang. . . . Last April, **Allen V. Clark** was transferred to Atlanta as Coca-Cola Food's director of corporation quality assurance and environmental monitoring. He says he'll have to travel a lot. . . . **Steven A. Evans** writes that he is the director of Advanced Technology Programs at the Rocketdyne Division of Rockwell International. His two sons are on their own, so he and wife Sheila are traveling and sailing. . . . **Bob Petrich** says he just became director of process re-engineering at Rohm and Haas. His two sons became chemical engineers: Rob is at FMC in Maine and Mike is in the PhD program at Cornell. His daughter is a business major in her junior year at Villanova. He and his wife are setting up their new home in a style they call "after children." . . . **Richard Merrill** is now doing freelance software consulting. He has one son at UMass/Amherst, and four daughters, one of whom just married. His quote: "Hooray!" Do you see a pattern here with our kids or what. (Sorry, I'm a psychoanalyst, I can't help it). . . . **Michael Denny**, now professor of economics at the University of Toronto, is "empty nesting" because his sons are now in college. I guess he's looking for company because he invites anyone going to Toronto to call him at (416) 978-6295.

Keep those cards and letters coming, especially you, **Michael J. Weisskoff**, who wrote for the first time in 30 years (yes, I'm counting!). Michael is a business-computing consultant living in Brighton. His wife, Carole, presented him with their first child on his 44th birthday (for the man who has everything). Their son should be about 8 by now. They won't be empty nesting for a while. Let me know what's happening!—**Shoel M. Cohen**, Dept. of Psychology, Nassau Community College, Garden City, NY 11530 or (516) 489-6465 (home) or Compuserve 71271,2627

it was—decision making in the presence of heavy duty, major league uncertainty!

On to the news. A brief note from **Joel Kalman** indicated that he is working on the Defense Satellite Program as a consultant for the U.S. Air Force Space and Missile Center in greater Los Angeles. He performs systems test and integration tasks using his almost 30 years of experience in telecommunications with Aerospace Corp.

In my continuing position as an adjunct professor at Dartmouth's Thayer School of Engineering, I receive all sorts of catalogs from textbook publishers. The most recent was from Addison-Wesley and it listed a 1992 text authored by **Donald Danielson** entitled *Vectors and Tensors in Engineering and Physics*. The accompanying brief bio mentions that Donald is on the faculty at the U.S. Naval Postgraduate School in Monterey, Calif.

Class President **Bob Popadic** received a letter from the Institute's Student Financial Aid Office reporting on the Class of 1964 Scholarship. **Alfredo Armendariz** continued as the Class of 1964 Scholar for the 1992-93 academic year. He compiled a fine academic record, was due to graduate last June, and had plans to do graduate work in environmental sciences. Clearly, the generosity of our class is appreciated by the Institute and is serving a fine purpose.

The "letter of the month" award goes—with gratitude—to **Jim Flink**. It is excerpted below: "After seven years at MIT on the Course XX faculty I moved in 1977 to Denmark as professor at the Royal Veterinary and Agricultural University in Copenhagen. I left in 1987 for industry—Novo Nordisk Food Diagnostics A/S, a small subsidiary of Novo Nordisk A/S. In 1992, I moved to the Biopharmaceuticals Division of Novo Nordisk A/S and am working on technology development, especially freeze drying technology. My title is research fellow, which gives the possibility for independent research (company funded) for 33 percent of my time. There is no question about it, it is exciting working in the biotechnology area.

"Besides my work, most of my time goes to my family. Agnethe has been working at Copenhagen Business University, organizing a special program of business for humanists. Sophia, our elder daughter, is 9, now in second grade. Her main love is horseback riding. Mathilde, 5, is halfway through kindergarten and can't wait to start school. Mathilde is a real 'dresses and skirts' girl with plenty of dolls to take care of, while Sophia is a 'pants' kid and all for climbing in trees, the higher the better.

"Two years ago, Sophia and Mathilde were 'stars' of a professional film on preventing accidents in the home. There was to be an official presentation, and also a book published based on the film. After the program was completed, Sophia while jumping from my desk chair in the cellar managed to break her arm and was in a cast for five weeks. Fortunately, the cast was removed two weeks before the official presentation, saving us from a little embarrassment.

"We will hope to make it to the United States in June 1994 for our reunion. WOW, 30 years already!"

Thanks, Jim, for all of the news and other interesting items. I'd be delighted to receive letters from more of you.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

in their offices in Kanagawa, Japan. . . .

George Livadas was in town for his son's graduation from MIT in May. George has been working as a naval architect and marine engineering consultant in Athens since his graduation. . . . **Ken Ross** reports he is currently CEO of Pillar Corp., a venture-financed software company developing client/server business applications. He has one son at Stanford and twins who are freshman at the University of Pennsylvania.

Jonathan Addeleston continues to be active in the software engineering community. He founded SPIN (the Software Process Improvement Network), a government contractor and academic consortium in the Washington, D.C., area a few years ago, and has recently joined an industry advisory group helping the University of Maryland start a graduate program in software engineering. He is VP for software engineering at Planning Research Corp. . . . I went to one of Lester Thurow's Sloan School business breakfasts and ran into **George McQuilken** and **Peter Gerstberger**. The topic was IT (information technology) effectiveness, and Peter, as might be expected, helped me put the topic in better perspective than our Sloan School professor-lecturer.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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I was so pleased to get news this month both through my own e-mail and the e-mail class network that **Jeff Kenton** has set up. **Fred Webb** writes that he has worked at Bolt, Beranek, and Newman in Cambridge pretty much since graduating from MIT. He lives in Littleton, Mass., and has three boys, an 8th grader, 12th grader, and pharmacy grad student. . . . **Martin McGowan** is in Cranford, N.J., with Bell Labs. He is at the Wireless Architecture Center, where his department made the Digital Radio Unit for TDMA wireless access. His wife, Pat, is at Unix System Labs. Their children and related activities: Chip (19), School of Visual Arts; Maura (16), clarinet; and Katie (12), sports.

Roger Samuel covered 27 years in his letter. After graduation he and wife, Pat, lived in Ann Arbor for grad school at the University of Michigan, then headed back to Boston for grad school at MIT and BU. Off to Seattle where Roger worked for Boeing while Pat got a PhD in chemistry at the University of Washington. They have been back in Massachusetts since 1977. Roger is a research manager in the Sloan School and also executive director of the International Center for Research on the Management of Technology. This is an industrially funded consortium of 15 companies that is looking at how organizations can get more and better results from their investment in technology. Pat is on the chemistry faculty at BU. They have a daughter, Emily, who has just finished her first year of dental school at Harvard.

Donald York has been appointed **Horace B. Horton** Professor of Astronomy and Astrophysics at the University of Chicago. He is now director of the Apache Point Observatory, where a 3.5-meter optical telescope and a 2.5-meter telescope for the Sloan Digital Sky Survey are being constructed. . . . **Timothy Connelly** joined QED Capital/QED Research as a principal last fall. The consulting practice specializes in economic and marketing analysis but he also handles mergers

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30th Reunion

A mere 30 years ago many of us were trying to wrestle with the choice of a senior thesis topic, not to mention thinking about where we would be heading after graduation. What fun

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Hajime Mitarai has now become president of Canon. He had been executive managing director of the firm. Mitarai continues to work

and acquisitions. . . . Sadly, **Matt Fichtenbaum** sent us news of the death of **Wayne Stevens** in Fairfield, Conn. Wayne had been with IBM for his whole career, most recently as a software architect. He also wrote a series of software books and gave classes and seminars for IBM.—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder NY 14226-4056; e-mail: vismit66@ubvms.cc.buffalo.edu

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Jim Williams, Jr. received Boston Edison's Seventh Annual Outstanding Professional Achievement Award in February. Jim is known for his commitment to minority student development. . . . **Mike Zuteck** writes that alternative energy generally, and wind energy specifically, are beginning to pick up steam under the new administration. Since Mike's primary business for the last 15 years has been wind turbine rotor design, he is looking to move into the field in a big way by buying a larger house to hold the continuing growth in files, reports, and computer equipment. . . . **Murray Katcher** is director of Community Health Programs at the University of Wisconsin Medical School where he promotes education of primary care health professionals for placement in medically underserved areas. . . . **Andrew Egendorf** was one of nine outstanding graduates inducted into the Cheltenham High School (Pennsylvania) Alumni Association Hall of Fame in April. Andrew attended Harvard Law School after MIT, and is now head of Agile Systems, Inc., a company he founded. He resides in Boston.

Guillermo Arnaud is a general surgeon on staff in the Army's 67th Combat Support Hospital in Wuerzburg, Germany. Guillermo, his wife, Debbie, and daughters Kateri and Elizabeth, are enjoying traveling through Europe, albeit with some apprehension about events in the Balkans. . . . **Bob Sullivan** writes that he was sorry to miss last year's reunion, but they had the happy alternative of his son's bar mitzvah. Bob and his family did manage a trip to Boston later in the summer, but reports that the 4th of July fireworks over the Charles were fogged in. . . . Last year **Daniel Drucker** was promoted to professor of mathematics at Wayne State University in Detroit. . . . **Stuart Orkin** has been elected to the American Academy. . . . **Richard Stein** is president of Richard J. Stein Associates, a technology brokerage and consulting firm headquartered in West Redding, Conn. He is the author of *Learning to Manage Technical Professionals*, a book that was published by Addison-Wesley in June. After MIT Richard received a master's and doctorate from Brooklyn Polytechnic Institute. He has been a senior scientist for Perkin-Elmer and has also held scientific staff positions with Balzers USA, Texas Instruments, GTE, and the National Bureau of Standards.—**Sharlotte and Jim Swanson**, co-secretaries, 878 Hoffman Terrace, Los Altos, CA 94024

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As I write this, the warm glow of last week's 25th Reunion still lingers, and we begin the next five years of class columns with renewed energy and enthusiasm. The reunion was simply wonderful—over 110 classmates, plus spouses and a few offspring, attended one or

more of the weekend's festivities, and everyone seemed to have a great time. We have received several special notes related to the reunion but cannot print all of them this month due to space limitations. A delightful note from **John Corwin** when I got back from Cambridge elegantly captured what I think a lot of us felt when he said that the reunion weekend "far exceeded my expectations as a rewarding and fun experience."

It was a typical, intense MIT extravaganza, packing in Pops, technical lectures (!), a dinner dance, an informal party, a reception at the President's house, assorted breakfasts and luncheons, an MIT barbeque, and interclass games. There were lots of highs to the weekend—seeing friends we hadn't seen for just about forever, discovering the interesting and exciting things all of us have been doing, rekindling common memories, still being able to recognize most of the people we once knew! Even the weather was uncharacteristically cooperative. As **Ken Morse** said, the only thing that could have made the weekend better would have been to have even more of us there. Keep that in mind when the 30th rolls around.

I cannot possibly list the names of all who played a role in making our festivities so successful, but I'd like to single out a few people for special mention: President **Rick Lufkin** did a masterful job of arrangements, even under the handicap of living outside the Boston area; **Ken Theriault** put together a spectacular reunion yearbook and statistical profile of the class (more on that later); and **Steve Finn** honchoed a strong fundraising effort. Rick, Ken, and Steve were ably assisted by several Alumni/ae Association staffers, who seemed to approach the reunion efforts with as much energy and enthusiasm as if it were their own reunion.

Among the numerous highlights of the weekend:

—A chance to see the real America's Cup, courtesy of Bill Koch, '62.

—The classmate who made the longest trip was **Hans Frizvold** from Norway. **Leonard Schrank**, who came from Belgium, deserves honorable mention.

—Announcement of our class gift. Assisted by a generous matching gift challenge from **Bob Metcalfe**, we raised about \$1.5 million, with additional contributions still expected. President Clinton's 25-year class, roughly the same size, raised \$1.15 million for Georgetown University.

—A reception for our class at the President's house, hosted by President Vest and his wife, Becky.

—Attendance at various events by Howard Johnson, Paul and Priscilla Gray, Mark Wrighton, and Bill Hecht.

—A "youngest baby" contest, won by Abby and Art Kalotkin, whose child was born October 1992.

—A strong showing in the interclass games. While at first blush we regretted losing by one measly point, coming in second has certain advantages—we do not have to supply next year's contestants with buttons!

—Elections for a slate of officers to serve for the next five years. Our new officers are Ken Theriault as president, **Ray Walsh** as vice president, Mike and I continue as secretary/treasurer (it will take the next five years to straighten out the finances from this reunion!), Ken Morse as reunion chair for our 30th, and **Barton Struck** as class agent (a slot filled after the reunion).

—A beautiful yearbook. The yearbook was provided to reunion attendees as part of their



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registration fee. However, many of the bios are from classmates who were not at the reunion. For those wishing copies, a limited number are available by sending a check for \$25 to Ken Theriault, 2634 Massachusetts Ave., Lexington, MA 02173. Only about two dozen copies are left, and requests will be filled first come, first served, so get your order in early.

In addition to the bios, the yearbook contains a fascinating statistical profile of the class, compiled by Ken Theriault. One of the more startling statistics is that 35 percent of the respondents claim millionaire status, compared with 20 percent in the class of '67 (and about 23 percent of the Harvard class of '68, which we happened to see in the *Boston Globe* after our reunion). We are either bigger liars, more self-deluded, or quite an extraordinary group. I'll vote for the latter. Another apparent anomaly is that only about 25 percent of the respondents reported being divorced one or more times, compared with 48 percent of the class of '66 (and almost half of the Harvard class of '68). Ken speculates that we must be awfully easy to get along with. I don't know. Maybe we're just more stubborn!

There are other interesting statistics in the reunion book. However, we clearly missed a few opportunities. Harvard's statistics included the percent admitting marital infidelity, pot-smoking history, percent current in psychotherapy, and percent having had an abortion or having been involved with a woman who had an abortion. We stuck to more mundane statistics, such as corporate rank held, numbers of hours worked, books published, and PCs owned.

We'll report more statistics in the future, as appropriate, and some of the doings of those we saw at the reunion or who reported particularly interesting experiences in our yearbook. However, we'd like to devote the remainder of this column to keeping up with what's in our mailbox.

The first letter was e-mailed to MIT from Israel by Ray Boxman in hopes of being available at the reunion. Alas, that didn't happen, but it caught up with us at home. I'll quote as much of it as possible. . . . "Congratulations on our 25th Reunion. It's been many a year since we sweated together, 'tooling' for a quiz, or pulling an all-nighter to finish a humanities paper. Somehow we survived all that, and even survived life in the real world, if we are writing or reading this letter. I haven't seen many of you over the years, except for occasional visits with Walt Oney, and rarer visits with John Blankenship. I would love to know what happened to Richard Smith—if you are reading this, please give a sign of life. My greetings to all of you on this occasion, and my regrets for not being there with you.

"Having been a poor correspondent, I have 25 years of updating to give, but I will keep it brief. After kicking around the Institute for a few years to pick up a PhD in what was then the Electrical Power Engineering Lab, I spent a brief stint in the Army in Georgia (my obligation from ROTC shrank to three months with the ending of the Vietnam War), and six weeks hiking in the deserts and parks of the Western U.S. with my wife Edie (a Tufts grad). We then lived two years in Philadelphia, where I researched vacuum interrupters at GE, and Edie picked up an MBA at the Wharton school.

"Edie and I emigrated to Israel in 1975, where I found a position on the Faculty of Engineering at Tel Aviv University, and Edie at Bank Leumi. We have been living in

Herzliya, 10 km north of Tel Aviv, since 1976, where we are raising four kids (Benjamin, 14; Jonathan, 12; Lillian, 9; and Yael, 5), two dogs, numerous fish, tadpoles, and other creepy crawlies, 18 fruit trees, and vegetables year 'round. I sometimes see our classmate Jerry Shohet, who lives two towns away and whose children attend the same school as mine. We still enjoy hiking and swimming. The whole family is very active in our local (conservative) synagogue, where I completed (thankfully) a term as president. None of the above will come as a great surprise to those who knew me from Hillel at MIT.

"I never intended an academic career, but so far I have stayed at TAU, publishing enough not to perish and indeed to make professor. The one fringe benefit of academia has been quite a bit of travel. Most of it has been to the U.S. and Europe. . . . I think in many ways we have become the minstrels of the modern age. Last year, however, we journeyed to China, where I sang for my supper (i.e., lectured) in Beijing, Xian, and Wuhan.

"The subject of my work has continued to be vacuum arcs (again no surprises), with special emphasis on developing techniques for high-rate deposition of metal and ceramic coatings. Either what I have been doing has some merit, or at least I write about it well, as our work received the Jaffee Foundation Award of the International Union of Electrochemistry and Surface Finishing in 1986, and I was named a fellow of the IEEE in 1989. With 'mid-life' approaching (albeit I define middle age as 10 years older than me), it seems one has to do something different: change wives, change jobs, write a book, or start a company. I have no intentions of changing wives, TAU seems stuck with me, but I am editing a book entitled *Vacuum Arc Science and Technology*, and some colleagues and I have started a company called Arc Technologies, Ltd., which will be producing and marketing arc deposition equipment services.

"With all my best wishes for a successful 25th Reunion."

Our other mail consists of a number of brief notes. . . . Robert Phair writes that "besides being a great career, biology offers interesting chances for world travel." This fall, he will travel to Jerusalem for the European Atherosclerosis Society meeting. . . . Darryl Pomiet reports that he recently joined US-Telecenters as VP for operations and moved back to Beacon Hill (from Cambridge). Ed graduated from Marlboro College and Ben from Harvard.

Russell Mersereau is "still Regents' Professor of electrical engineering at Georgia Tech." . . . Morry Markovitz writes that his book about zero-coupon bonds, *How to Beat the Street with Plan Z*, was recently published by John Wiley and Sons. . . . Joel Robinson is currently director of Environmental Sciences for Unocal Corp., Los Angeles. He was recently operations manager of Unocal's "Geyser Field," a geosteam electric project of 2,000 MW capacity, north of San Francisco. He previously conducted technology development for deep offshore, Arctic oil projects.

Finally, two classmates share the prize this month for both attending the reunion and writing in. . . . Jennifer Rudd is a physician in private practice (internal medicine and gastroenterology) in East Orange, N.J., and has a 13-year-old daughter. . . . We reported earlier on Art Kalotkin's baby, Charles David. Art and Abby were married in 1986 and live in Brookline, Mass., where he owns and manages real estate for a living. He obtained an SM from UCLA in 1972. He is still active in pho-

tography, doing work for non-profits—and taking plenty of baby pictures. Leisure time is spent traveling, this summer to Yellowstone National Park.

The reunion "residuals" will keep us going for a while, but by the time you read this, we will certainly be needing new material. Let us close by reminding you of the rules. We report the news; we don't make it up. When the mailbox is empty, the column is correspondingly short. MIT occasionally forwards us a few press releases and news clippings, but 95 percent of our material comes directly from you. If you haven't seen your name in print for a while—and especially if you didn't attend the reunion—please send MIT a note on one of those envelopes they're always sending with requests for contributions, or write us a letter at the following address.—Gail and Mike Marcus, 8026 Cypress Grove Lane, Cabin John, MD 20818

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Please send news for this column to: Eugene F. Mallove, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Sandy Harlow writes that he is still with Procter & Gamble, in sales, but now located at Braintree and living in Hingham, Mass. He and his wife, Marilyn, are raising three boys—Dan and Bill, 9, and Bob, 7. Sandy is beginning to dabble in the local musical theater and helped his wife in a campaign to override the property tax limit for local school funding by "standing in the rain at the town dump holding a sign asking voters for the funds needed just to keep any more teachers from being laid off."

Sandy also tells us about other classmates. . . . John Light's son Bo is now at MIT and his grade on his first chemistry quiz was higher than what Sandy and John received combined. Obviously, "Bo knows chemistry." . . . Sandy also sees Terry Michael and his family every year or so. Terry's wife, Bonnie, and daughter Carolyn visited while on a college scouting trip last year. . . . On New Year's Day for the last two years, Sandy and his family have visited with the families of Jim Lyneis and Steve Milligan for "a winter walk in the woods."

We know that it seems early, but we're beginning to think about preparations for our 25th Reunion in June '95. Karen has been talking to some colleagues at the *New York Times* who worked on their 25th Reunion books (Yale and Harvard) and would like to put together a crew to do one for our class. Any volunteers? Maybe we could try our skill at desktop publishing. Anyone experienced? If you have any ideas or might be interested in helping, please drop us a note.—Greg and Karen Arenson, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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Jim Mannoia has become the academic vice-president at Houghton College in Houghton, N.Y., after 15 years as professor of philosophy at Westmont College in Santa Barbara, Calif. His son graduates from Cate School and is off to Africa to work with children in Mozam-

bique for a year before starting college at Carlton or Saint Olaf in September 1994. Jim recently tracked down **Charlie Lengel**, who is living in Silicon Valley, running his own computer company that does PC mainframe software interfaces. He would love to know what happened to **Joel Fox**, and anyone who knows can write him (and hopefully it will be forwarded) at 955 LaPaz, Santa Barbara, CA 93108. . . . **John Malarkey** has just resigned from the Bank of America in San Francisco, where he has been for the past six years. He is joining Bechtel in San Francisco and expects to be assigned for the first year or two to the Euro Tunnel project in London.—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

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Adnan Akant continues to manage bond portfolios and proprietary risk at Fischer Francis Trees & Watts in New York City where he has been a partner since 1985. His spouse, **Alison** (Wellesley '77), has been home with their children Sara (6) and Adam (3) since she left her career with the Manhattan DA in 1989. . . . **LA Law** (in its real life version) has been the profession of **Daniel Case** for the past 17 years. His leisure time is dominated by family activities with his two kids who are 6 and 4. The last time that he played drums was in 1969 at a fraternity party, but he has recently taken them up again. (Apparently, the children did not make enough noise). Dan wishes the best to all of his former housemates at Sig Ep and we would love to have their news for the class notes.

Carliss Baldwin is now teaching people in the senior executives program at the Harvard Business School instead of teaching doctoral and MBA candidates. Husband, **Randy Hawthorne**, '71, recently celebrated his 20th reunion at the Harvard Business School with a tremendous turn-out of his MBA small section. He continues to finance the construction of affordable housing around the country. He is an executive at the Boston Financial Group working in the Investment Real Estate area. I had the pleasure of visiting them on a recent weekend in Stockbridge, where their daughter **Clare** won two ribbons in a horse show. Their son **Nick** was looking forward to returning home to Brookline so he could have his birthday party, celebrating turning 4 years old. . . . **Thomas W. Eagar** is the director of the Materials Processing Center at MIT and a member of the faculty in the Materials Science and Engineering Department. He is also co-director of the Leaders for Manufacturing Program. He has been elected to the board of Nashua Corp.

Michael J. Rowny has been promoted from being the CFO of ICF International, Inc. to being part of a three-person office of the chairman. He is very busy with work, but not too busy to enjoy his children. **Melissa** is fine. . . . **Bernie Gitler** is a cardiologist in private practice in Westchester, N.Y. His wife, **Ellen Spielman Gitler**, '73, has sent more news of the family, which will be found in the 1973 class notes.

Well, that's it for now. Please send in your additional news. Since the last time I wrote I have moved to a larger apartment in the same building in Florida. The address is almost the same, except now I am in apartment #1001, which looks directly at the Gulf of Mexico. It's hot in Florida now, so I am up north as I write this, but please keep sending your

news!—**Wendy Elaine Erb**, co-secretary, 6001 Pelican Bay Blvd., Apt. 1001, Naples, FL 33963

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Mark Udden writes of having missed the reunion to participate in a retreat to redesign the Baylor College of Medicine curriculum. **Rebecca** and the two girls will travel with Mark to France this summer—a break from his work on a hematology research project for NASA Space Life Sciences 2, a mission scheduled for an August or September launch.

Steve Book writes that his California home was lost in the 1991 Oakland Hills fire, but they have moved to a beautiful new home in nearby Piedmont. Daughter **Annie** ('11) says her new bedroom will "last forever and ever," while **Ben** ('06) already has made new friends in town. . . . **Howard Harris** is now associate director for corporate development at AMP Inc. of Harrisburg, Pa., the world leader in electrical/electronic interconnect devices. His team has global responsibility for mergers and acquisitions, and equity/venture capital investments. He and Linda have two fine sons, **Hunter** ('01) and **Mark** ('04).

Douglas Levene is still in New York City for "who knows how long." He notes his offspring as well, **Jacqueline** ('11) and **Theo** ('13). . . . **Ellen (Spielman) Gitler** writes that "it's hard to imagine it has been 20 years since we left Boston." She is working full-time as an internist, and for several years as the director of cardiac rehabilitation at Burke Rehabilitation Hospital in White Plains, N.Y. Husband **Bernie**, '72, is a cardiologist in private practice, and their spare time (?) is well-filled with a set of sports fans and participants named **Sefanie** ('05), **Cynthia** ('07), and **Bryan** ('08). . . . **Ron Gittelsohn** is in God's country (Chapel Hill, N.C.), having moved back from Switzerland after six years there. A fraternity brother working at Research Triangle Park provided him with leads on a software job, and he is stateside with **Margrit** and **Simone** ('06) and **Claude** ('07).

A press release from the Jesuits salutes the ordination of **Gregory Chisholm** as a Roman Catholic priest. **Greg** holds bachelor, master's, and a doctoral degree from MIT, the last in 1980. The same year he entered the New England Province of the Society of Jesus, and has taught and studied at several Jesuit-run universities during the 1980s. The ordination took place June 19th this year, and was performed by the Icelandic Bishop.



Gregory Chisholm

op. The best wishes of the class go with Greg on his calling.

Hope all went well at reunion time. As you are aware, I could not go owing to unavoidable conflict, so if you elected a new secretary in my absence, may God have mercy on his soul. Else I'll be with you another decade, bringing glee and sadness from priest and physician, technologist and woodsman; I know naught of other classes, but we've sure got 'em all. Write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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20th Reunion

Those of you who took Professor **Hans Lukas Teuber's** 9.00 "Introduction to Psychology" may well remember Teuber's Law of Perception: What you see is a function of what you're looking for. Your faithful scribe remembered it over the past few days in constructing a postmortem on the shortest-lasting job I ever had. In February when I wrote here about my new job I was wild about it. By the time the column was in your hands in May I was out. Ever have a really short-lived job? Well, it's necessary to clean out everything before the next great thing arrives, such as my new new job, which I will not rave about for fear of jinxing. If I still have it, you'll hear all about it in my next column.

The award for Black Engineer of the Year this year goes to **Jonathan Abokwah**. Jonathan was honored at an awards presentation in Baltimore in February for his outstanding technical achievement and his contributions to the semiconductor industry. Jonathan was chosen from a field of more than 300 nominees. He and his wife and two children live in Tempe, Ariz. . . . The Reverend **George Harper** wrote to inform us that as of this fall he will be professor of church history and theology at Alliance Biblical Seminary in Manila, Republic of the Philippines.

One of our number, **Kenneth Vaca**, passed away in early January this year, of an apparent heart attack. At the time of his passing, **Ken** was a research scientist, working in the Department of Neurology at the Baylor College of Medicine in Houston. . . . Another classmate, **Richard Dupuy**, formerly of Minneapolis, passed away in late November. There are no other details at this time. Kinda makes you think: Is there anything I should be grateful for now, rather than later?

A word of welcome came this way from **Edwin Arippol**, who has been living in Italy for 11 years now. Edwin says he's involved in the import and export of fruit and vegetables, and if you're in the Milano area, give him a call at the office: 551-80-351. . . . The Oxford University Press has recently published *The Oxford Dictionary of American Legal Quotations*, edited by our own **Fred Shapiro**. That's an amazing accomplishment!

Don't! Do not! Do not forget our 20th Reunion, coming June of '94. This is another in a series of reminders. Our reunions have always been fun for this writer. Hardly anybody knows anybody else, it's true, but that doesn't seem to get in the way of making friends. Being an MIT grad, and attending the reunion, gives you a lot in common with the other people there. . . . Vacation time's over. Time to sit down and write to me with news.—**Lionel Goulet**, co-secretary, 115 Albemarle Road, Waltham, MA 02154-8133, (617) 899-9694

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Greetings. Here's the news. **Gary N. Fostel** writes, "I staged a dramatic come-from-behind victory in the local School Board election, running on a GNURD Platform: more math and science, especially in elementary school. Concomitantly, I also keep the 'see no evil, do no evil, hear no evil' tax activists from getting a majority on the board and laying off a slew of teachers. . . . until next year anyway." . . . And this from **Lila Kobylak Kung**: "I'm still busy doing consulting in the area of sensor and

industrial automation product marketing. The kids are growing up, my oldest, Yung-Shin, will be starting college this fall."

This spring, Patricia Callahan was named director of personnel and executive VP of



Patricia Callahan

Wells Fargo Bank in San Francisco. Pat will be responsible for the bank's central personnel functions, including employee benefits, payroll, staff analysis, and employee relations. Pat started her banking career in 1977 at Crocker Bank, where she held various positions before being promoted to senior VP with Crocker

Corporate Services in 1985. After Crocker's merger with Wells Fargo Bank in 1986, Pat became manager of operations and systems for Wells Fargo's Wholesale Services Group. She managed operations and systems for the bank's Real Estate Group for the past two years before accepting her current position.

I received a newspaper clipping (sorry, but the name of the paper and date were cut off) that reported that Matthew E. Farber wrote a letter to Hillary Rodham Clinton with his views on the nation's health care issue and, lo and behold, Matt was invited to the White House to be part of a health care discussion group. Matt, who specializes in diseases and surgery of the retina and vitreous humor, was the only private-practice physician participating in this session of the Health Care Professions Review Group, a subgroup of President Clinton's Health Care Reform Commission. Matt spent March 28-30 in Washington, D.C., meeting with Dr. Lawrence F. Jindra, a White House fellow and head of the Health Professions Group, and other physicians. Let's hope the Commission's results are as good as the input they got from Matt.

Jeff Bokor writes, "I recently left Bell Labs to try the academic life again, this time on the other side, as a professor of electrical engineering at UC Berkeley. All I can say is we sure never appreciated how hard the faculty works! But, it's great to be back on a university campus."

Finally, I am sorry to report the death of our classmate, Ira C. Levine on October 21, 1992.

That's all for now. Keep writing.—Jennifer Gordon, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036; or 18 Montgomery Place, Brooklyn, NY 11215

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Please send news. We urgently need it.

From Steve Edelson: "All is well here. Family doing fine—we're looking forward to a white-water-rafting vacation (low degree of difficulty). . . . This spring I took a couple of courses at MIT. Listener status—no grades, not much attention to problem sets—just sit, listen, and learn. It was great to be among the students (undergrad courses) and just hang out. It is amazing that after 18 years, almost nothing has changed. Same mega-blackboards filled with equation after equation. It was a terrible strain at first, but after a few weeks, most of the background

material emerged hazily from my memory—enough for me to figure out the gist of the lecture. I highly recommend it for anyone who has some time and wants to feel young again."

From Raphael Blumkin: "To bring you fully up-to-date, nothing much has changed on the professional front. I'm still a project manager at Chemical Bank's internal consulting group. The work can be, and often has been, exciting and challenging, especially during the last couple of years in the wake of our merger with Manny Hanny. My work has stimulated my interest in information technology to such an extent that I intend to return to school in the fall and study for a master's degree in information systems in my supposedly spare time, while continuing to work. And that's it for my professional life. . . . The really BIG NEWS involves my personal life and a wonderful lady named Elena Shmir, to whom I became engaged in mid-January. Elena works as a programmer, for a competing bank, humorously enough, and was originally trained as an engineer in her native St. Petersburg, which was called Leningrad when she left. We plan to marry in early August, (secretary's note: This column was prepared in late June!) and I could not possibly be happier. I hope all this is not too shocking to those who remember me as a diehard bachelor."

Neil Macklin writes: "I'm now director of systems software for the Macintosh Systems Division at Apple Computer. We have three kids: Derek, 5, Doug, 3, and Richard, 1. I actually missed the last reunion because Richard was born a few days before it. I wanted to send regards to everybody, and say I'll be at the 20th."

Your secretary is deeply saddened to report the death of Mark Koupal. According to the notification which I have received, Mark died on August 18, 1992. However, we do not know the cause.

In closing, your secretary is, as usual, pleading with you to send news. Even with my phone, fax, and modem, I cannot be everywhere. Your news contributions are essential for these Notes. Write, phone, fax—any medium, but please send news. Now!—Arthur J. Carp, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, fax: (516) 295-3230

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I received e-mail from Sergio D. Cabrera, who is on the electrical engineering faculty at the University of Texas at El Paso. He reports that even though he has not been able to go back to Cambridge for a class reunion since graduation, he has gone back to Boston a couple of times for conferences. He enjoys living in El Paso, especially for its climate and its proximity to Mexico. He writes, "After living in Houston for seven years and State College, Pa., for another four, I am really noticing and enjoying the sunny weather, which makes me feel great every morning. I moved to El Paso in January 1992 and have been extremely happy to be 'back' home, which for me is any place on the U.S./Mexico border." His area of specialty is digital signal processing; he mentions that UTEP is an up-and-coming institution in a fast-growing area. At 60 percent, they have one of the highest percentages of Hispanic students in the continental U.S. He would be happy to hear from classmates who happen to be in the El Paso area.

Donald Silverstein and his wife, Ruth, were preparing to celebrate the first birthday of their daughter, Alison, when he penned a quick note to include with his latest Alumni/ae Fund contribution. He is still living outside of Washington, D.C., in Kensington, Md., and wonders, "Dan Flamen, where are you?" . . . Joel Lederman reports that his consulting business, Lederman Engineering, had its best year in 1992 and continues strong into this year. In order to balance his existence, he still spends his free time playing rugby, racing sailboats, and working for Club Med. Over the last six or seven years, he has taught windsurfing and sailing at various Club Med villages in Mexico and the Caribbean for one or two months each year.

A press release from the Downtown (Washington, D.C.) Jaycees served to announce that William A. O'Brien III, MD, is one of 10 individuals to be honored with the prestigious Arthur S. Flemming Award. This award recognizes excellence in government service. William, who is affiliated with the Department of Veterans Affairs Medical Center in West Los Angeles, was honored for his scientific contributions toward improved understanding of the mechanisms of infection with the AIDS virus. The release describes William as an extremely gifted physician and scientist with broad expertise in both the clinical and molecular biological aspects of HIV infection. Much congratulations!

That's all the news that's passed my way since last issue. I feel sure that there are more of you out there with information to share—I accept all, from the exciting to the mundane, so please take a moment to write or e-mail your news! Postcards from all over the world are especially appreciated! Address all correspondence to your faithful secretary, Ninamarie Maragioglio, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522 or e-mail to hertz@xip.nrl.navy.mil

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Please send news for this column to: Jim Bidigare, secretary, 9095 North Street Rd., NW, Newark, OH 43055-9538, (614) 745-2676

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15th Reunion

William York and wife, Shawn Lampron (Harvard '79), are still living in Mountain View, Calif., with two-year-old son, Michael. William recently joined Xerox and is working on a commercial product based on a PARC Research effort in the area of abstract information visualization. . . .

Richard Byrne writes, "Tell all the Phi Deltas that I am now back in the Boston area. My latest challenges are learning how to coach my 9-year-old son's sports teams and understanding the subtleties of my 5-year-old daughter's tap dancing recitals." . . . Sandra Viarengo is at Intel, working on transferring their Pentium microprocessor technology from the Santa Clara development site to production facilities in Dublin, Ireland, and Rio Rancho, New Mexico. Sandra and her husband, Michael, were expecting their first child around press time. Sandra, please write with a baby update!

Brad Myers and his wife, already the parents of two sons, had twin boys last November. Brad is still a professor at Carnegie-Mellon. . . . Steve Gordon and his wife, Mary, celebrated

their daughter, Elizabeth's first birthday recently. Six years ago, Steve founded Intelligent Automation Systems, a Cambridge-based manufacturing engineering consulting company with 12 employees. The company recently introduced a new 3D sensing technology at the Robot & Vision show in Detroit. Over the past year, they have been helping the Whitehead Institute decode the human genome by developing laboratory automation equipment.

Bogy Cimoszko has been working since 1991 for the Europea Bank in London, handling debt and equity investments for private companies in Poland. She writes, "Most investments are in the basic industries, but I am always on the lookout for technology-based companies founded on unique ideas." . . . **Russell Kalis** and his wife, Sue, along with daughters Meghan and Lisa, are enjoying their new home in sunny Maple Grove, Minn., where Russell is working for Parker Hannifin.

Cindi Parner Lynch has become a principal at the San Francisco office of CSC Index, a management consulting firm. Cindi works with clients on issues involving organizational effectiveness and design. . . . Congratulations to **Kate (Malcolm) Stohman**, who was one of 20 honored at a Tribute to Women in Industry luncheon sponsored by the Greater Lawrence YMCA in Lawrence, Mass. The honorees were chosen by their employers or colleagues in area business, industry, and professions. Kate is sensor manufacturing manager at Hewlett-Packard in Andover, supervising 85 manufacturing professionals.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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Only three notes this month. Congratulations to **Joan Solomon Griffin** and husband, Jim, who became parents to Christopher Isaac Griffin on April 16. Joan says she is currently conducting an experiment in sleep deprivation. Let us know the results! . . . More congratulations to **Marian (Stein) Nodine** who just completed a PhD in computer science at Brown University. She will be graduating with her husband, Mark (SM '82), who completed a doctorate last summer. They are parents to Anna, 2, and Tim, who will be in kindergarten this fall. . . . Last, but not least, **Donald Brinkley** writes that he recently joined Sybase, Inc. in Emeryville, Calif. as product manager for secure products in the Server Products Group. Donald moved to Clayton and says if you're in the area give him a call, especially Phi Deltas.

Send your news to: **Kim Zaugg**, secretary, 549 Fairfield Road, Canton, MI 48188; vayda@erim.org

81

Well, that was an enjoyable summer, wasn't it? Hope you all hung on to the cliffs, evaded the raptors, and didn't accept offers you should have refused (can you tell I'm writing this from the Hollywood environment?).

Kid stuff: **Lance Choos**, his wife, Julie, and daughter, Samantha, are proud to announce the birth of their second daughter, Elizabeth Lang Choos, last February. Lance and co. are living in West Norwalk, Conn., where Julie is on the mommy track and Lance is an institutional salesman with Greenwich Capital Mar-

kets of Greenwich, Conn. . . . **Gary Tom** and wife, Paulette, had their first child, Andrew Tom, in October 1992. Gary supports his new addition working as a software designer for Tandem Computers, while Paulette is also mothering full-time. . . . We are informed that **Tom Chang** and wife, Joan Vondra, have also had their first baby, Miranda, last March. Tom and Joan heartily endorse their local midwifery birthing facility and recommend the experience to everyone who has need of such services. Since July 1991, Tom has been an assistant professor of radiology at the University of Pittsburgh, and would be glad to hear from classmates at his e-mail address (tsch@med.pitt.edu).

From far-off Okinawa we hear from **Debye (Meadows) Galaska**. Debye relates that she is still in the Air Force, and is now the head of the Pacific environmental consultant division and director of the analytical laboratory. On the home front, she tells us that life with five (!) children is hectic but lots of fun, especially since she's blessed with a wonderful husband who loves the children as much as she does. Her stepdaughter is about to graduate from high school in 1994, while the "baby" is already four years old. And in a particularly welcome development, Debye has finally paid off her last MIT loan! Now that must be a wonderful feeling!

Time off from kid stuff: After five years of pediatric office practice, **Sarah Axel** is taking a year off. As of summer's end Sarah was sailing with Chris Doyle, '85, in the Dartmouth, Mass., area. And when the snow starts to fall, she and Chris will be heading for Vail, Colo., and lots of skiing. Sarah would love to hear from any of you downhill racers in the Rockies this winter.

No kidding: I received an interesting letter from a classmate who has "finally graduated on the 14-year plan." **Lincoln Ross** started off as a member of the class of '81, although he thinks it would be more accurate to call him "class of '86 +/- 5." He dropped back in (or maybe dived back in) in fall 1990 to work on his Course 21E degree, a joint major in ocean engineering and writing, "including the first poetry thesis at MIT in a while." Lincoln found it quite a satisfying project, although at times he was tearing hair (which has since grown back, thank goodness). After graduation, he worked for a small company making oceanographic buoys. He served in a multifunctional capacity—engineer, supervisor, and almost everything else. Now that that's completed, Lincoln is looking for another engineering position, "or at least one where I can rub a couple of brain cells together now and then." He's been living in Waltham recently, but is open to relocation if and when he finds his dream job, and that doesn't exclude moving to Podunk, Iowa. Lincoln can be reached at (617) 891-0332, and he'd love to hear from classmates.—**Mike Gerardi**, secretary, 3372 Olive St., Huntington Park, CA 90255, (213) 587-2929 (h), (310) 553-5050 (w)

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Nancy Huelsmann writes that she will be recognized as a 1993 Distinguished New Engineer by the Society of Women Engineers at the national convention in Chicago in June and she is moving to Spain for six months to work for Hewlett-Packard in Barcelona. . . . **Keith Sawyer** has been very busy being published in journals and pre-

senting at conferences while wrapping up a PhD program in psychology and finding the time to get engaged to Elinor Keen from Tampa, Fla. . . . **John Canning** and his wife, June Fox, are expecting their first child in October. John is finishing up a post-doctoral fellowship at NTT's Basic Research Laboratories.

Richard Segal had a recent article on the economy published in the *Kennebec Journal*. He is chief international economist for Thomson Financial Networks in London. . . . **Charlie Frankel** is the director of project management for the Delta Project at CCC Information Services in Chicago. He is acting again and was cast as an understudy in a major production.—**Helen (Fray) Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008; e-mail: fanucci#m#_helen@msgate.corp.apple.com

83

Our 10th Reunion was a smashing success, the highlight of which was an entrepreneurial forum on Saturday morning. In the forum, **Michael Goldberger**, founder of Moda Systems, **Matthew Haggerty**, Founder of Product Genesis, and **Daniel Schwinn**, Founder of Shiva, traded war stories with Class of '68 entrepreneurs, which included **Richard Karash** of Innovation Associates, **Bob Metcalf**, the designer of Ethernet and CEO of InfoWorld Publishing and **Ken Morse** of Aspen Technology. The event packed 10-250 and was considered a highlight of the reunion weekend for all classes.

The night before featured a cocktail party that was attended by 120 classmates. In addition several prominent faculty and staff members also joined us at the Friday night party. They included former MIT President **Paul Gray** and his wife **Priscilla**, Professor **Woody Flowers** (of 2.70 and *Scientific American Frontiers* fame), Professors **Robert Hulsiser**, **Marjorie Resnick**, **August Witt**, and a special appearance by Professor **Harold Reiche**.

On Sunday, the highly contested elections for class officers were held. **Hyun-A Park** was re-elected president; **Arleen Taylor** was elected vice-president; **Steve Eschenbach**, class agent; **Sarah Bingman**, treasurer; and I was re-elected as class secretary. Members-at-large are **Eric Gold**, **Mike McConnell**, and **Betsy Pollack**. Special thanks for a great weekend go to both **Hyun-A** and **Sarah Bingman**, our reunion chair. It was a lot of fun, and our class participation exceeded all of our expectations.

And now for some news. **John Piotti** and his wife, **Susan**, are back from their year-long trip



to Europe, which was interrupted on a couple of occasions for some lengthy sailing trips. John and Susan have once again taken up residence in Albion, Maine. . . . **Bril Flint** and his wife, Karen, recently had a baby girl, **Blair**. Bril has been appointed VP for strategic planning for EMI Records Group in North America. Bril was formerly EMI Music's senior director of worldwide strategy and planning. . . . **Earl**

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Bartley, M.D., recently completed his total joint arthroplasty fellowship in Atlanta at Piedmont Hospital and Emory University. Shortly, Earl, his wife, Trudy (Wellesley '81), and their twin boys, Chris and Tyler, age 3, will be moving to Columbus, Ohio, where Earl will be joining a practice working primarily at Park Medical Center. . . . **Damion Wicker** has recently joined Chemical Venture Partners to work on medical technology opportunities.

Richard S. Teal writes from Westchester, Pa., that he is sick and tired of having his class affiliation confused. Richard devotes his loyalty completely to the class of '83 and is giving our column the exclusive on all his news (there is none to report for now). . . . **Perry Bonanni** writes that he is interested in getting a copy of a back issue of this magazine that mentions his name. I don't have a copy of the back issue but maybe mention in this issue will suffice. Perry is now working at General Electric Research & Development. . . . Lieutenant **James Miller, Jr.**, writes that he is now in the Bay Area on the USS *Carl Vincent*. James is living in Alameda, Calif. with his wife, Connie, and son, James III (also known as Trey).

Jude Paganelli writes from Ridgewood, N.J. He and wife, Elizabeth, are the proud parents of a new son, Nicholas, who joined 7-year old sister, Kathleen. . . . **Michael O'Malley** writes that he and his wife, Kris-sy, are expecting their first child in September 1993. Michael's computer-generated video walk-through of the Tokyo International Forum will be showing at the Museum of Modern Art in New York over the summer. . . . **Paul Cunningham** has been with Mobile Oil in Dallas for the last six years. The past year led Paul to travels in Argentina, Bolivia, and Algeria. Otherwise, you will find Paul playing soccer, sailing, or scuba diving. You can reach him at pscun-nin@dal.mobile.com.—**Jonathan Goldstein**, secretary, c/o TA Associates, 45 Milk St., Boston, MA 02109, (fax): (617) 574-6789

84 10th Reunion

Duncan Hughes married Vicki Aanstoots, Notre Dame '86, in December of 1992. Now he watches football on TV and cares! Duncan is working with helmet-mounted displays in Boeing's V-22 simulator. . . . **Mark Radlauer** says hi to all Fijis. He is doing great in Colorado. The third annual ski trip had about 15 Fiji brothers from the classes of '84-'88. Next year in Steamboat. Mark is completing his residency in emergency medicine and will be staying in Denver. Mark has gotten engaged to Linda Carr. . . . **Charles Markham** has sold his condo and has hopefully settled in a new home in Norwell, Mass.—**Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, 617-275-0213 (home), e-mail: hbr@mitre.org.

85

Greetings everyone. A short column this month because yours truly is feeling the weight of the academic millstone.

Many people have inquired as to how it is possible to publish an incorrect death notice. The case in this column occurred because an alumni mailing was sent to the last known address of **Dimitri Kazarinoff**. The mail was

returned with the notice that the addressee was deceased. This was the basis of the report in the column.

Martin Anderson returned to school last fall to pursue a master's degree in environmental engineering at UC/Davis. There he met up with **Kain Nilsson** who is a psychology intern at the UC/D counseling center. **Greg Smith**, '86, also lives in his dorm and is a biology graduate student. . . . **John Mart** writes that he was married to **Elke Bureths** in 1987. He has two children—**Kelsey** and **Colton**, and he is installation law officer, Marine Corps Air Station, Kaneohe Bay, Hawaii. He sees **Joe Megna**, '86, and **Dan Curran**.

Arnie Burke and wife, Susan, announce the birth of their daughter, **Rachel Eileen**, on June 14, 1992 in Westminster, Calif. . . . **Linda Sheehan** and **Roger Perkins** announce the birth of their daughter, **Madeleine Laura Sheehan Perkins**, on May 18. Their other child, **Adam**, just turned 2. . . . **Loren (Frost) Crawford** writes on stationery won by her dog at an obedience match. She says that she is adjusting to not having her life dictated by semesters since completing a master's degree in psychology. Being a mom is a lot more work than graduate school, but the boss, son **Bobby**, is a lot nicer.

Heidi Brun has been a patent agent for four years and is now working for an intellectual property lawyer in Tel Aviv. She says her husband, **David Goldfarb**, '84, is still playing with computers and may grow up some day.

From the academic jungle—**Bill Messner**, secretary, 5927 Alder St., Pittsburgh, PA 15232, (412) 361-4180, bmessner@andrew.cmu.edu

86

Happy Fourth of July. Got a few letters this month. Thanks to those of you who write. It makes my job a lot easier and you don't end up being bored with all the current details of my life.

John Park was elected First VP at W.P. Carey, Inc., a New York real-estate investment company. John has been with the company since 1987. . . . **Walid Nasrallah** has done quite a lot in the two years since our reunion. He folded the software startup company he was tinkering with, worked on one reconstruction and one new construction project in Kuwait, returned to school at Stanford for a civil engineering PhD, grew restless on the West Coast, applied for a transfer to MIT, got in but without funding, and has finally settled on a lifestyle of shuttling between working the Middle East (on construction and a revised version of the software startup) and working toward his degree in bearable doses. . . . **Simone Pottenger** continues work on the Boeing 777 program, where she's trying to implement a digital databus system into the aircraft. They are currently on the verge of black-box testing and integration, a phase that should prove interesting. Simone's also working with the FAA to certify the new system. With all of this, she is anxiously awaiting two weeks in the Alps.

Joseph Megna has come a long way from Shearson Lehman Brothers and trading government bonds on Wall Street. After living overseas for two years in Tokyo and Sydney while working for an American financial-based software company during its startup phase, Joseph is now self-employed as a consultant based in Honolulu, and living aboard a 35-foot yacht. . . . **Dan Harasty** is working

on Personal Communications Services (PCS) for Bellcore. Dan forecasts that soon everyone will be able to carry a portable phone about the size of a deck of cards, which will only cost as much as regular telephone service. . . . **Sergio Ajuria** got married in 1990 to Stephanie Easterday (Wellesley, '88). Sergio is currently working for Motorola in Austin as a senior engineer in the R&D semiconductor products sector. . . . **Dr. Rich Rusin** is working at 3M in dental products. He got married in 1991 to Laurie Demit (Wellesley). Rich also graduated from Northwestern University with a PhD in materials science.

Sharon Israel sent me a nice letter. She is just down the street from me in Arlington, Va., clerking for Judge Alan Lourie of the U.S. Court of Appeals for the Federal Circuit. Her two-year clerkship will be over the end of July, when she'll take a couple of months off and travel to Eastern Europe. Sharon will then move to Houston, where she'll be working for Fish & Richardson (an intellectual property firm). Since F&R is based out of Boston, Sharon's fairly certain she'll have many opportunities to make it back to the Boston area. Over Fourth of July, Sharon was planning to meet **Mary Ystuea**, **Marta Diaz**, and **Elizabeth Dernbach** in Toronto for a short vacation. This will be their second annual trip together: last year they went on a Windjammer Barefoot Cruise in the Caribbean. Last month, Sharon and Beth met **Hannah Bond** in Baltimore, where they took in an Orioles game (back when you could get tickets). Hannah will receive an MBA from New York University in December. She's been working on her degree while working full-time for Martin Marietta (formerly GE) in Princeton, N.J. Beth is still working for Westinghouse in Monroeville, Pa. Marta just finished her first year of the MBA program at the University of Michigan. She's spending the summer in Saulte Ste. Marie, Mich., working for the Chippewas doing strategic planning (with their casinos). Mary has been traveling a lot in her training position with Semaphore outside of Boston. Sharon recently ran into **John Villani** in the D.C. area. He's working for a small law firm in Syracuse. Last fall, Sharon and **Kim Hunter** attended **Vivienne Lee's** wedding to **Jim Beehtold** (?). **Carla Johnson**, **Patty Murray**, and **Danny Kim** also attended. Kim is still in New Hampshire keeping busy with her needlework business. Vivienne and Jim are both with Procter & Gamble in Cincinnati, Ohio. . . . **Rose Joseph** will finally finish a PhD from Northwestern this fall.

Marilyn Oberhardt also dropped me a line. She and hubby Fred are moving out west. She separates from the Air Force on July 15 (I know you'll miss that blue polyester leisure suit!). Marilyn's taken a research position at University of California at Berkeley Space Sciences Lab. Fred will be doing a two-year fellowship in neuro-oncology at University of California San Francisco. Marilyn attended her brother's graduation from MIT on May 28. Seems it was quite a different experience from ours: much drier! . . . **Mary (Bayalis) Prettyman** had a baby boy, **Andrew Barrett**, on April 10, weighing in at 8 pounds, 6 ounces.

Erik and I took off to Italy for two weeks at the end of May to enjoy that last fling before our lives as we know them come to a screeching halt. We had a wonderful time (even managed to be two days out of Florence before the Uffizi was bombed). Of course, I worried the entire time about our pup, who, as it turned

out, managed fine without us (wait'll I have to leave the kid at day care!) . . . Thanks for the news.—**Mary C. Engebret**, secretary, 21305 Arrowhead Ct., Ashburn, VA 22011, (703) 729-6568

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Hope everyone had a good summer! Y'all must be pretty busy, since I haven't heard from too many of you.

I did hear from **Bridget Fitzpatrick**, who writes that she is currently the facility energy coordinator for Hoechst Celanese's Bishop, Tex., facility. Having won the 1991 Hoechst Celanese President's Quality Award for an off-line (plant) model which she developed, Bridget is moving to the position of optimization process control engineer, where she will be implementing an on-line model that it is hoped will save hundreds of thousands of dollars per year in energy costs. . . . An MIT education pays off when put to work!

Grace (Ueng) Trombetta moved from General Mills in Minneapolis to San Francisco to be with her husband. Grace is currently working in marketing for the Clorox Co.

Steve Berczuk writes that he was married to **Lena Davis** (College of William Mary '87) on June 13th of this year. In the wedding party from MIT were **Paul Couto**, **Carl LaCombe**, '86, and **Sharalee Field**, '88. Also attending the wedding were **Marco Murgia** with his wife, **Susan**, **Linda Chao**, **Linda Marinelli**, and **George Borhegyi**. Lena and Steve plan to keep their respective surnames, and will continue to reside in Arlington, Mass. Steve also mentioned that he's celebrating his one-year anniversary at the MIT Center for Space Research, where he's writing data-analysis software for the X-Ray Timing Explorer Satellite, and trying to teach astrophysicists about object-oriented programming.

Tom Abell is in Libertyville, Ill., where he's working for Motorola on a project dealing with concurrent engineering/CAD/CAM through this December. After completing his project, Tom plans to return to MIT's Leadership for Manufacturing Program, and will graduate in June 1994.

Finally, **Jerry Hershkovitz** got to introduce **Matt Richter** to the Austin, Tex., version of Tosci's Ice Cream: Amy's (they even have a Dark Chocolate #9). Matt was down for the weekend with his fiancée, **Susan**, to help her find an apartment, etc., in Austin, where she will start a new job as a professor at the University of Texas. Matt plans to follow her to Austin when he finishes a PhD at Berkeley.

Until next month. . . . **Jack Leifer** 2703 Swisher St. #202 Austin, TX 78705; (512) 472-7507; e-mail: leifer@ccwf.cc.utexas.edu; fax: (512) 472-7546

88

The Class of '88 5th Reunion was a huge success! It was great to see so many of you and catch up on the last five years. Our reunion gift fund-raising effort ended the year with a bang. We were able to substantially increase our Class of '88 Scholarship Fund and present MIT with a gift that represented the strength of our continued support. The reunion couldn't have been so successful without the dedication, creativity, and hard work of the committees and chairs involved. **Lisa Martin**, president, would personally like to thank and

acknowledge all of those contributions: **Joyce-lyn Koehler** and **Sheila Neville**, reunion co-chairs; **Christine Chu**, reunion gift chair; **Jim Casamento**, nominations chair; and **Abdon Ruiz**, reunion treasurer.

Reunion committee members included **Sharon Els**, **Erik Heels**, **Suzanne Maggioni**, **Abdon Ruiz**, **Kimber Lynn Drake**, **Carla Kapikian**, **Lon Sunshine**, **Reggie Tucker**, **Cathy Singer**, **Mike Donohoe**, and **Jim Casamento**. Reunion gift committee members: **Doug Clevenger**, **Mike Couris**, **Diane Duckworth**, **Tracy Gabridge**, **Craig Jungwirth**, **Debbie Lee**, **Martha Lyman**, **Kelly O'Neill**, **Anthony Owen**, **Gary Webster**, **Earl Yen**, **Ken Yu**, and **Kimber Lynn Drake**.

Lisa Martin also thanks our past class officers for their efforts both in planning the reunion and in supporting class activities for the past five years: **Tracy Gabridge**, VP; **Grace** (I feel silly typing this) **Ma**, secretary; **Linda Chang**, treasurer; **Debbie Lee**, class agent; and **Kimber Lynn Drake**, class member-at-large.

I'd first like to congratulate the new class officers: **Lisa Martin** will be continuing as president, **Scott Lichtman** is VP, and **Cathy Singer** will be replacing me as secretary. Class treasurer is **Abdon Ruiz**.

Being as this is my last column, I'd like to personally thank everyone for their letters over the past five years. I've really enjoyed my duties as secretary and have had a lot of fun writing the Class Notes.

Some reunion news of my own. . . unfortunately for me, I only made one event, the formal at the World Trade Center. I came down with a deathly cold and had to forego the Sunday activities, and had arrived too late Friday night to partake of the Baker House dinner. I did get to see a good representation on Saturday night from Baker House, the East Campus crew, AEP1, and Kappa Sig. . . . and let me tell you, those Kappa Sigs are *still* incorrigible! By the way, Emporio Armanis, I was there, where were you?! Among those present at the formal were: **Lisa Martin**, **Abdon Ruiz**, **George Pappas**, **Carlos Francisci**, **Cathy Singer**, **Chris Saito**, **Mike Couris**, **Pat Cobler**, **Bob Bielinski**, **Young Shin**, **Mark Meixner**, **Kimber Lynn Drake**, **Mike Fox**, **Dave Silldorff**. . . . From here, I must say my memory fades. please write Cathy and let her relay your reunion memories! I think everyone enjoyed themselves at the reunion. I know I enjoyed seeing people I haven't seen in five years and catching up on each other.

William Sun writes to say he is "still alive and around" and wants to read about himself in this next issue, so here you are! I wish you had told us more about what you are up to...maybe next time, huh?

Florence Rolston just graduated from Morehouse School of Medicine and is presently doing residency in OB-GYN at SUNY, Stonybrook. . . . **Randy Hertzman** is currently living in Denver working for a small environmental consulting firm as a groundwater hydrologist (just what exactly does a groundwater hydrologist do?) He does a lot of skiing in the winter and camping in the summer (I just answered my own question.)

Steven Schondorf is working at Ford Motor Co. on the electric vehicle for 1998. He spent the last two years at MIT earning a master's in aerospace engineering and technology policy. For his thesis, he built a micro-rover for Mars exploration. In February 1992, he met **Kristin Slanina** ('91), fell head over heels in love, got married in July 1993, and is still head over heels in love.

Sharon Weber finished her first year of a two-year program at Tufts University to get a

joint Master of Science between the Departments of Urban and Environmental Policy and Civil and Environmental Engineering. Pretty impressive! . . . Joel Simansky is living outside of St. Louis, installing night-vision heads-up displays into helicopters. He says "hi" to all his classmates.

Fang-Pin Lee has the job I want! She is a designer at the Royal Ontario Museum in Toronto developing exhibits and galleries. . . . **Adam Sawicki** is still working at Boeing Helicopters in Rotorcraft structures research. He bought a home in December of 1992 and is halfway through an MBA program at Villanova University. He received the American Helicopter Society's Directors Award in May 1993 and recently attended **Tim Kelly's** wedding.

Kevin Oliveira graduated from William and Mary's School of Law. He spent the summer studying for the bar and began working in northern Virginia in August for the firm **Odin, Feldman and Pottleman** of Fairfax, Va. He will be working as a litigator in two departments: intellectual property litigation and commercial litigation.

John Seo got a PhD in May 1991 in biophysics at Harvard and did a brief postdoc at Brandeis. As of this year, he is STRIPS trader at Swiss Bank Corp. in New York City, working on exotic foreign currency options. I'd say that's quite a change in career directions! He married **Stello Cho** in August 1988 and they have three children: Phillip, Alexander, and Nicole!

Tim Vogelsang recently received a PhD in economics from Princeton. He began a job as assistant professor at Cornell University and married **Ann Hendry**, whom he met at Princeton, on July 31. More wedding news from **Steve Beaudoin**, who married **Diane Bauer** in Austin, Tex. . . . **Mark Hanson** flew in from George Washington University to witness the festivities. Steve and Diane spent their honeymoon in St. Lucia and are now both back in grad school at NC State. Both are about two years away from PhDs. Congratulations to all of you!

Douglas Bank and his wife, Susan, had their first child in September. They also bought their first house. Douglas is currently taking

classes at Northwestern's Kellogg School of Management and will graduate in June 1994. Congrats to you two!

LeAnn Yee recently moved to the Big Apple and took an apartment on the posh and chic Upper West Side. She graduated from Kellogg. Graduating with her was **Lisa Bishop**. LeAnn will be working with Goldman Sachs and Co. in the equities division in New York. Welcome to New York and hope to see you around!

This concludes my final issue of Class Notes. I am in my second year of general surgery residency at NYU-Bellevue and loving every minute of it (really!). Anyway, my address and phone number are the same if you ever want to drop me a line: **Grace Ma**, 155 East 29th, #32H, New York, NY 10016; (212) 447-1925, but for Class Notes, write **Cathy Singer**, secretary, 131 Main St., #3, Andover, MA 01810. Thank you again and keep in touch!

89 5th Reunion

I've gotten a few submissions for the class calendar so far, but I still need to beg for more, so please send those pics in! There is also a new submission format, videotape (either VHS or 8 mm). All submissions will be returned.

Here are this month's list of people to please write in: **Steve Douglas**, **Pat Goshtigian**, **Lina Muryanto**, **Kris Sheahan**. What are y'all up to? If anyone knows about any of these people or anyone else, please write in!

Susie Lee is currently a grad student in math at Cornell. Susie hopes to graduate next year with a PhD. . . . **Karen Koyama** is working as a propulsion systems engineer for TRW Space and Electronics Group in Redondo Beach, Calif. Karen is engaged to be married in 1994, and has been playing volleyball and working on an MS at USC.

Paul Monaghan has finished his U.S. Naval Service as a lieutenant with his requisite chest full of medals, and is now back to civilian life. Paul is now attending the Fuqua School of Business at Duke. . . . **David Fleming** is working on a PhD at the University of Maryland, "trying to crush composites in new and complicated ways." David married **Katy Hoffman** (Wellesley '90) on September 26, 1992. **Robie Silbercleit**, '88, **Dave Henry**, **Quentin Turchette**, '91, and **Joe Orso** were among those in attendance.

Laura (Ryzowicz) Rapacioli and her husband, Mark, '87 have moved to Mahopac, N.Y. Laura stayed at home caring for their son Dominick, who was a year old (as of July). She has started law school this fall, and hopes to graduate in four years. She is planning on studying either environmental or corporate law. . . . **Ezra Peisach** is back in graduate school, pursuing a PhD in biophysics at Brandeis.

Xavier Sarabia married **Christina Lauchlan**, UPenn '91, in September '92. The two of them are now living in their new home east of Atlanta. Xavier is working at C. R. Bard as a research scientist. Christina is working on a PhD at the University of Georgia. . . . **Ron Dagostino** is doing system administration and object-oriented development at Fidelity Investments in Boston. Ron hopes to attend Northeastern this fall with the high-tech MBA program.

I received a postcard from **Suzanne Driscoll Plump**, who was traveling in Israel and France with her husband, Andy, who had some lab work to do. They toured the Old City of Jerusalem, and saw some Christian, Jewish,

Armenian, and Muslim holy sites, as well as the 2,000-year-old Masada fortress. After floating in the Dead Sea, they took some mud baths and sulfur showers at Ein Gedi Spa. Suzanne and Andy moved out to California in August, where Suzanne will be continuing her studies at Stanford.

Krista (Beed) Pastrone writes with a calendar submission, and to say that she is doing fine, and expecting a second child on September 1st.

I ran into **Mike Berube** and his wife, Michelle, this July 3rd in front of the Hatch Shell. Mike and Michelle were recently married, and now have a house in Birmingham, Mich., where Mike is working for Chrysler. **Bill Jarrold** was also there, after driving from Austin, Tex., as was **David Goldstone**, who was working for a large Boston law firm this past summer. Bill is working at MCC on an artificial intelligence program called CYC, and David will be finishing up at Harvard this year.

Well, that's it for this month. Thanks again to everyone who wrote in, especially those who sent calendar submissions!—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142; phone: (617) 225-6680; fax: (617) 253-2673; e-mail: tripleh@athena.mit.edu or henry_houh@mit.edu

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Steve Shen recently visited **Chris Lamb** and his wife in Raleigh, N.C. Chris is completing a master's degree at NC State and has recently bought a house, which he is renovating from the ground up. . . . In June, **Jeff Ford** was married to his sweetheart from Clemson University, where he had received a master's in architecture. Their wedding was held in Springfield, Ohio.

In other news from the Midwest, **Jeff Souza** is working for Ford Motor Co. in Ohio. . . . **Raquel D'Oyen** is in the materials science and engineering PhD program at Northwestern University. She's having a great time out there and is engaged to be married in June 1994! . . . **Stefan Treatman** just received a master's degree in mathematics from the University of Michigan and is continuing on a PhD. He writes that once again he sat on the bench for the Wolverine's varsity basketball team. In fact, if you watch the videotape of this year's NCAA championship game, you can see Stefan yelling at Michigan player **Chris Webber** to call a time out! Stefan has also been keeping busy singing in the Arts Choral at Michigan and playing lots of softball. . . . **Marian Shih** is also at the University of Michigan. Marian is working on a PhD in physics.

Manik Hinchey is in the PhD program in political science at Yale. . . . **Todd Sachs** is out at Stanford, also working for a PhD. Todd is studying magnetic resonance as it relates to medical imaging. His project deals with motion correction in MRI of the heart. In his spare time, Todd has been active in music and theater activities. Last fall, Todd was in a Stanford Drama Production. . . . And after spending the summer working for Ford Motor Credit, I'm back at Sloan, finishing up a master's degree. It's been three years since our graduation and I'm still waiting to hear from everyone. Please write in and let us know what you've been up to! Send news to: **Ning Peng**, secretary, 483 Beacon St., #41, Boston, MA 02115, (617) 267-9083, or ning@athena.mit.edu

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"Hey!" writes Aimee Quijano, "I'm in Baltimore finishing my master's degree program in maternal and child health at Johns Hopkins. I've seen some other MIT graduates at the med school like Dawn Mitzner and Susie Jackson. Mary Elizabeth Hannon and I always bump into other on the bus, and I've also seen Eleanor Huff up by the Homewood Campus." During the summer of 1992, Aimee worked on a substance abuse and HIV prevention program with Navajo and Hopi Indians in Arizona and met Lauralee Grizzaffi and Brian Byrd in Flagstaff. "We did the tourist thing," writes Aimee, "and hiked the canyon and went to Sedona's red rocks!" Aimee sends news that Lauralee is working for Honeywell in St. Petersburg, Fla. Next year, Aimee will be working for the Children's Defense Fund in Washington, D.C.

After working at the National Institutes of Health, Teresa Zimmers entered a PhD program in biochemistry and cellular and molecular biology at Johns Hopkins. She spent the summer in Maui, Oahu, the Solomon Islands, and Fiji. She's also experimenting with a non-profit science education initiative. "Anyone with a clever idea about how to teach a particular scientific principle," writes Teresa, "please contact me!"

Brigette Pak finished her first year as a graduate student at the Kennedy School of Government at Harvard last spring. "How do I like my first year in the master's public policy program?" asks Brigette, then answers, "It's a lot of fun and excitement (?), but the problem sets and papers I could do without." . . . John Kimble works for Mars & Co., a strategy consulting firm in Greenwich, Conn. He has been to Guadalajara, Mexico, four times in the past four months, "for work, of course," and says the trips almost make him miss Boston weather! . . . John Sell received a master's in mechanical engineering from Stanford in June and now lives in San Jose, Calif. John works with automation for AdStar, which is a wholly-owned subsidiary of IBM.

Mike Beachy sends a postcard of the poster for the new movie *Reservoir Dogs* and writes that he will be ending his term in the "real" world this summer by returning to school at Columbia in the fall to pursue a PhD in chemistry.

Please send news to: Andrew Strehle, secretary, 566 Commonwealth Ave., #406, Boston, MA 02215, (617) 262-3495

Well, gang, another summer has come and gone and more congratulations are due this month. On September 25, Cecilia Linnell was married to Keith Colmer, '89, in Worcester, Mass. They will be living in Colorado, and after Keith finishes pilot training, he will be flying F-16's for the Colorado National Air Guard. Cecilia will transfer from Merck in Pennsylvania to a position in Denver as a sales representative. Cecilia informs me that Jean Condon has also been at Merck & Co. this past year and that Sean Campbell was married this past summer.

Marine 2nd Lieutenant Melissa D. Kuo and Marine 2nd Lt. Erin D. Coady recently graduated from The Basic School at Marine Corps Combat Development Command in

Quantico, Va. The course includes instruction on land navigation, marksmanship, tactics, military law, personnel administration, Marine Corps history and traditions, communications, and the techniques of military instruction. Officer candidates are also taught leadership by example and the importance of teamwork, in addition to participating in a demanding physical conditioning program.

David Gustafson, USN, "Gooseman," writes that the Navy has moved him to Dallas, Tex., where he is a construction project manager with the title of assistant resident officer in charge of construction. He also sends the best of luck to Tim Salter, Gus Gutierrez, and Kurt Steltenpohl who by now are probably finished with the Navy's Nuclear Power Pipeline.

Our very own superstar rower Brad Layton has written about his full-time training for the 1993 World University Games Sculling Team and the National Sculling Team. Wow! Good luck—hope all is going well.

Dan Green called to say that he is living in Midland, Mich., near Saginaw Bay, where he's recently bought a house and is working for Dow Chemical. He's working on their design of a new plant including unit operations, specifying equipment, and other responsibilities. He has also been Lightning sailing quite often lately.

Dan has heard from Rob Bingel who has been spending the last number of months in Somalia right by the Indian Ocean. Unfortunately, he hasn't had much inclination to swim since a woman was attacked by a shark. Rob got his commission from the Army and was head of a munitions group in Seattle, which means he was the officer in charge of a group operating forklifts to move palettes of ordnances (bombs, bullets, guns). He is now in charge of a group of 38 in Somalia. People have been bombed three or four kilometers away from where he is stationed, and helicopters are always flying overhead—so it is hard to sleep even when they are not being attacked. Rob says, "Business is booming." Not only that, he sleeps right at the end of an airfield and as he writes, "I'd be an unfortunate guest at the biggest barbecue in Somalia if a plane went down." Rob should be back in the States this month—Godspeed.

Andy Sullivan has been working for Exxon in the Process Research Department near Rockaway, N.J., where he just bought a house. . . . Dawn Watkins was married to John Chow in Ohio on June 19. She is working on the Humane Genome Project (mapping all genes in the human body) at University of Michigan. Classmates in attendance included: Seth Cohen, Albert Cheng, Sue Pauwels Katz, Mike Gull (who is doing some type of contracting work for the Pentagon), Jeff Falkowsky (who is working on a chemical engineering master's at Rensselaer Polytechnic Institute), and Theresa Derderian (who is doing polymer research at school in Pennsylvania). Please keep writing to me.—Leslie Barnett, secretary, P.O. Box 7604, Aspen, CO 81611, or call (303) 920-7769

Please send news for this column to: Mari Madsen, secretary, 85 Alberta Rd., Brookline, MA 02167

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I CIVIL AND ENVIRONMENTAL ENGINEERING

Dennis A. Fitzpatrick, SM '81, has been named president of The O'Connell Companies of Holyoke, Mass. Fitzpatrick has been president of Daniel O'Connell's Sons since 1984. . . .

Jerome B. York, Jr., SM '61, has been named CFO at IBM in Armonk, N.Y. Previously, York was VP at Chrysler Corp. in Skippack, Pa. While at Chrysler, York was credited with developing and implementing Chrysler's \$3-billion cost-cutting effort, overseeing the issuance of more than \$3 billion in securities and supervising renegotiation of loans and the sale of more than \$3 billion in non-core assets. . . .

John F. Kennedy, SM '76, president of KRI Management, a construction, consulting, planning, and management firm in Lexington, Mass., has been elected a trustee of Merrimack College in North Andover, Mass. Kennedy, who is a 1968 graduate of the college, has clients in the institutional, healthcare, and biotech/medical research fields.

II MECHANICAL ENGINEERING

From Boonton, N.J., **Peter Kalustian, SM '34**, writes: "My process engineering consulting business continues at a less active pace, due to the current economic situation, which shows signs of improving. My downhill skiing, too, continues with some 63 days this past season. I spent two weeks at Mammoth Mountain in California, where they had more snow than any other winter for a long time. The conditions were the best ever. Health-wise, I am fine and am looking forward to my 60th MIT reunion next year." . . .

Robert Siegel, ScD '53, has been given the American Institute of Aeronautics and Astronautics Thermophysics Award in 1993. The citation read for "outstanding contributions to thermophysics including boiling in low gravity, transient forced and free convection, solidification, and thermal radiation." The award consists of an engraved bronze medal, certificate of citation, and a rosette pin. . . . **William A. O'Brien III, '77 (VII)**, SM '78, is one of 10 federal government employees selected to receive the Arthur S. Flemming Award, recognizing excellence in government service. O'Brien, a physician in the Department of Veteran Affairs, was cited

for "his outstanding scientific contributions directed towards improved understanding of the mechanisms of infection with the AIDS virus. O'Brien's innovative laboratory studies have identified virus determinants that are responsible for efficient infection of macrophages. Infection of these cells with the AIDS virus is associated with many diseases caused directly by the virus, in particular the AIDS dementia complex." . . .



Jerry Wood

Jerry R. Wood, SM '67, deputy branch chief in the Turbo-machinery Flow Physics Branch at the NASA Lewis Research Center in Cleveland, has been granted a 1992 Lewis Distinguished Publication Award for co-writing "Experimental and Computational Investigation of the NASA Low-Speed Centrifugal Compressor Flow Field." The paper discusses the combined research of laser-based measurement systems with a computational model to gain understanding of the airflow in centrifugal compressors, which are widely used in small jet engines that power helicopters, small aircraft, cruise missiles, and in automobile turbochargers. Wood currently investigates flow physics in fan and compressor components of gas turbine engines using sophisticated computer programs. . . . **Paul A. Croce, SM '64**, an engineer at Factory Mutual Research Corp. in Norwood, Mass., has been named a Fellow of ASME. Croce is manager of protection and risk analysis research at his company. . . . The MIT Graduate Student Council awarded Graduate Teaching Awards to **Steven Eppinger, '83, SM '84, ScD '88**, from the Sloan School of Management, and **William Durfee, SM '81, PhD '85**, a Course II professor. Annually, each graduate student nominates a professor or lecturer and one is selected from each of the five schools at the Institute.

The Association of Alumni and Alumnae has been notified that Rear Admiral **James A. Prichard, SM '38, (USN, ret.)**, died on June 16, 1987. No further information was provided.

III MATERIALS SCIENCE AND ENGINEERING

Joe Lane, ScD '50, was profiled last year in the *Mount Vernon Gazette*, in Virginia. The article focused on Lane's love of violins and violin repair. He does not repair top-notch violins for professionals, opting instead to work on low-cost instruments for beginning students or second, "locker" violins so young musicians don't have to carry expensive instruments from home to school daily. Lane participates in a local orchestra and string ensemble and says he has no desire to play professionally. "Playing as an amateur is great," he said. Retired from the National Academy of Sciences, Lane worked at the University of Chicago on the Manhattan Project earlier in his career. . . . **Joseph I. Goldstein, '60, SM '62, ScD '64**, the R.D. Stout Professor of material science and engineering at Lehigh University in Bethlehem, Pa., has been named a co-winner of the Joseph and Eleanor Libsch Research Award for outstanding achievement and distinction in research. Goldstein specializes in electron microscopy and its application to meteorites and diffusion controlled transformations. As a principal investigator in NASA's Lunar Sample Program from 1969-80, he studied returned lunar samples from Apollo flights. From 1982-90, he served as VP for research and graduate studies at Lehigh. . . . **Jeffrey E. Jacob, SM '87, SM '87 (TPP)**, has been promoted to director of venture development, a newly created position at Research Corp. Technologies in Tucson, Ariz. Previously, he was a technology transfer associate for RCT's physical sciences group. Jacob manages the planning, creation, and development of startup companies based on RCT innovations. He is also responsible for implementing market plans and ultimate closure of license or venture arrangements. . . . **George Krauss, SM '58, ScD '61**, has been inducted into Cheltenham High School Alumni Association's Hall of Fame. Krauss, who is professor and director of research at the Colorado School of Mines, is a 1951 graduate of the Pennsylvania high school. . . . **Thomas W. Eagar, '72, ScD '75**, Course III professor and co-director of the Leaders for Manufacturing Program, has been elected to the board of directors at the Nashua Corp. in Nashua, N.H. . . . **Reinhardt Schuhmann, Jr., ScD '38**, Purdue professor emeritus of materials engineering, has been awarded an honorary doctorate by Purdue University in

DEGREE CODES

AE	Aeronautical Engineer
BE	Building Engineer
CE	Civil Engineer
CHE	Chemical Engineer
CSE	Computer Science Engineer
DPH	Doctor of Public Health
EAA	Aeronautical & Astronautical Engineer
EE	Electrical Engineer
EGD	Doctor of Engineering

ENE	Environmental Engineer
MAA	Master in Architecture Advanced Studies
MAE	Materials Engineer
MAR	Master in Architecture
MCP	Master in City Planning
ME	Mechanical Engineer
MET	Meteorologist
MIE	Mineral Engineer
MME	Marine Mechanical Engineer
MNG	Master in Engineering

MPH	Master in Public Health
MTE	Metallurgical Engineer
NA	Naval Architect
NE	Naval Engineer
NUE	Nuclear Engineer
OCE	Ocean Engineer
PhD	Doctor in Philosophy
ScD	Doctor of Science
SE	Sanitary Engineer
SM	Master of Science

West Lafayette, Ind. In 1954, Schuhmann was recruited by the dean of engineering to lead the rebuilding of Purdue's educational and research programs in metallurgical and materials engineering. In 1959 the School of Metallurgical Engineering was formed and Schuhmann became its first head. His contributions to engineering have centered primarily on original applications of physical chemistry and chemical thermodynamics to high-temperature processes of extracting metals, especially the smelting of copper and lead. He was on the MIT faculty as an instructor, assistant professor, and associate



Wayne Hasz

professor before he went to Purdue. ... **Wayne C. Hasz, SM '84**, has joined the GE R&D Center as a materials engineer. Hasz was a senior technical associate with Bell Labs in Murray Hill, N.J., from 1980-81, a research specialist and research assistant at MIT from 1981-84, a materials engineer with Sprague Electric Co.

in North Adams, Mass., from 1985-86, and a research assistant and instructor at RPI from 1986-93.

The Association of Alumni and Alumnae has been notified that **James W. Montgomery, SM '37**, of Wetaskiwin, Alberta, Canada, died on July 31, 1992. No further information was provided.

IV ARCHITECTURE

T. Gunney Harboe, MAR '88, writes: "Since graduation I have been working for McClier, a large A/E, design/build firm in Chicago. I was the project architect for the restoration and rehabilitation of the Rookery, which has received two awards from the American Institute of Architects: the 1993 National Honor Award and a 1993 Interior Architecture Award of Excellence." ... From Tokyo, **Masaaki Sakuta, '60**, sends word: "I am professor and vice-dean of Nihon University's College of Science & Engineering (Oceanic Architecture & Engineering Department). I am director and chair of the board of the Visualization Society of Japan, Inc. My son, Shigeru, is a visiting researcher at MIT now." ... **Joel Wachman, SM '90**, is living in Paris, where he is self-employed as a computer consultant. His company is called Trio Document Systems. ... **Amos E. Joel, Jr., '40, SM '42**, executive consultant at AT&T, International, Inc., and **Charles M. Correa, MAR '55**, of Correa Associates in Bombay, India, have both been elected



Martha Lampkin

to the American Academy of Arts and Sciences. ... **Martha Lampkin, MCP '81, MAA '81**, principal at Sasaki Associates, Inc., in Watertown, Mass., has been elected a Fellow of the American Institute of Architects. The highest honor given by the AIA to its members (except for the Gold Medal), advancement to Fellowship recognizes both the individ-

ual's architectural achievement and contribution to the profession and to society. Lampkin is currently involved in the design of the Central Area Circulator light rail transit project in Chicago, as well as the master plan for the Arnold Arboretum of Harvard University. Other recent projects include the renovation of the Boston Common Parking Garage and campus master plans for Case Western Reserve University in Cleveland, the University of Massachusetts at Lowell, and the University of Illinois in Urbana-Champaign. ... **Lawrence Vale, SM '88**, has been selected to be the holder of the Mitsui Career Development Professorship at MIT. Vale, who teaches in Course XI, is the director of that department's undergraduate program.

Joseph J. Schiffer, MAR '61, of Dennis, Mass., died on May 31, 1993. Schiffer won the Boston Society of Architects traveling scholarship award in 1955, and studied the cathedrals of Europe. After attending MIT on the Ames Traveling Fellowship, Schiffer won the Chamberlain Prize and the Special Rotch Prize. From 1957-64 he taught architecture at MIT and from 1962-64 he also taught at Wellesley. In 1957 he established his own firm which he operated until his retirement in 1989. He designed churches, homes, libraries, and buildings along Route 128. ... **James S. Rowley, MCP '50**, of West Yarmouth, Mass., died on June 6, 1993. Rowley was owner of the architectural firm J.S. Rowley and Associates. He was a member of the board of directors of the South Shore Housing Development Corp. and a volunteer with the Cape Cod AIDS Council.

The Association of Alumni and Alumnae has been notified of the following deaths: **Frank V. Gandola, '41**, of Cleveland, Ohio, on May 27, 1989; **Hugh L. McMath, SM '36**, of New York, N.Y., on November 15, 1992; and **Thomas J. Chang, MAR '36**, of Venice, Calif., in 1993. There was no further information provided.

V CHEMISTRY

Stefan Unger, PhD '71, sends word from Palo Alto, Calif., "I am president and CEO of Oxford Molecular, Inc., producing pharmaceutical and biotechnology software." ... **Pfizer, Inc.**, headquartered in New York, N.Y., has undergone some internal shifting. **Barry M. Bloom, '48, PhD '51**, executive VP for R&D has retired from the company and its board of directors. He was replaced by John F. Niblack who in turn was succeeded by **George M. Milne, Jr., PhD '69**, who assumed the position of president of Central Research, which is the global pharmaceutical, animal health, and food science research organization of Pfizer, Inc. Headquartered in Groton, Conn., Central Research employs 4,000 scientists and medical personnel around the world. Bloom joined Pfizer in 1952 as a research chemist. He served as a research supervisor and director of medicinal products before being named president of Central Research in 1971. The same year Bloom was elected a corporate officer of Pfizer, Inc., and was elected to the board of directors in 1973. In 1990 he was named senior VP and executive VP last year. Milne joined Pfizer in 1970, progressing through several management positions in new drug discovery. ... **Howard E. Simmons, Jr., '51, PhD '54**, retired VP for research at Du Pont, is the 1994 winner of the American Chemical Society's Priestley Medal, the nation's highest award in chemistry. The solid-gold award was instituted by the ACS in 1922 to commemorate the work of Joseph Priestley, the British-born discoverer of oxygen who emigrated to America in 1794. Simmons'

citation reads: "Throughout his professional career, Simmons has consistently been in the forefront of chemical research and has had immense impact on scientists in his own generation and those who followed. Under his leadership, the Central Research Laboratory at Du Pont made important advances in several areas including, chlorofluorocarbon replacements, electronic materials, high-temperature superconducting materials, polymer technology, biotechnology, and supercomputer applications. Simmons has a chemical reaction named after him: the Simmons-Smith reaction. It is an organic chemical reaction showing the conversion of simple olefins (class of compounds known as alkenes) to cyclopropanes." ...

Charles P. Casey, PhD '68, chemistry professor at the University of Wisconsin at Madison, **Tobin J. Marks, PhD '71**, chemistry professor at Northwestern University in Evanston, Ill., **John T. Groves, '65**, chemistry professor at Princeton University, and **Julius Rebek, Jr., PhD '70**, MIT professor of chemistry, have all been elected new members of the American Academy of Arts and Sciences. ... **Stephen J. Lippard, PhD '65**, the Arthur Amos Noyes Professor of Chemistry at MIT, and **Elias J. Corey, Jr., '48, PhD '51**, of Harvard University, have been elected members of the Institute of Medicine. With their election, members make a commitment to devote a significant amount of volunteer time on committees engaged in a broad range of studies on health policy issues. Current institute projects include the identification of measures to strengthen U.S. dental education, and the issues and implications of tests used to detect genetic disorders.

Robert L. Cleland, SM '51 (X), PhD '57, of Norwich, Vt., died on April 29, 1993, while conducting research at Uppsala University in Sweden. Cleland was a professor emeritus of chemistry at Dartmouth College in Hanover, N.H. From 1956-58 he was a research associate at Cornell University. In 1958 and 1959 he was a Fulbright research scholar at the University of Leiden in the Netherlands. Cleland joined Dartmouth in 1960 as a teacher and research scholar of physical chemistry. He specialized in the study of biomolecules in cartilage and other connective tissues. He retired in 1989. ... The Association of Alumni and Alumnae has been notified that **Laura E. Case, PhD '54**, of Winchester, Mass., died on October 17, 1987. No further information was provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Abeer A. Alwan, SM '86, EE '87, PhD '92, writes: "I am now an assistant professor at the Electrical Engineering Department at UCLA. I have established a Speech Processing Laboratory in the department and several speech and hearing-related projects are underway." ... **Keith E. Camhi, SM '91 (XV), SM '91**, reports: "I have been helping with the manufacture of a custom computer for use by Bloomberg Financial Information Services. And I'm starting a company to provide computer services to the fitness industry." ... From Quaker Hill, Conn., **Roy Angell, SM '57**, sends word: "I work part-time at Mystic Seaport Museum Planetarium and enjoy studying cosmogony and cosmology." ... **Arthur L. Fox, SM '72**, writes: "I have formed a venture capital fund called Royalty Capital Fund (RCF). RCF invests in new and existing companies in exchange for a royalty on company revenue. The entrepreneurs do not have to sell their equity." ... **Robert Stricker, SM '70**, has been named executive VP for fixed-income investments at Continental Asset Man-

agement. Previously he was senior VP at Continental Corp. Continental is located in New York City. . . . **Mark Atkeson**, SM '91 (XV), SM '91, has been given an Outstanding Achievement Award for Extraordinary Leadership/Management Effectiveness and Outstanding Contribution to the Corporation or a Business Unit at United Technologies (UTC), where Atkeson is a research engineer in product development and manufacturing. Atkeson "played a key role in helping UTC establish rapid prototyping programs in Italy and Spain. The programs will help UTC's European operations to quickly and cost-effectively produce prototype parts, Atkeson worked with the European units to identify technical needs, educate users, perform pilot projects, and plan collaborations and investments. He also helped write a proposal that netted a \$1 million funding award for rapid prototyping research," according to *The Researcher*. . . . **Walter J. Gajda, Jr.**, SM '65, PhD '70, chair of electrical engineering at the University of Missouri at Rolla, has been named vice chancellor for academic affairs at the university. Gajda, who is also a Rutledge-Emerson Electric Distinguished Professor of Electrical Engineering at UMR, joined the UMR faculty in 1986 as professor and chair of electrical engineering. Before that he served on the faculty of the University of Notre Dame. . . . The American Academy of Orthopaedic Surgeons has recognized the work of Course VI Professor **Alan J. Grodzinsky**, '71, SM '71, ScD '74, and his colleagues with the Ann Doner Vaughn Kappa Delta Award for 1993. Grodzinsky is a leader of the Continuum Electromechanics Group in the Laboratory for Electromagnetic and Electronic Systems (LEES). He was the principal investigator for the paper, "Physical Regulation of Cartilage Matrix Metabolism." The recognition is for a body of work over five to six years. In its announcement, the academy said: "The researchers were able to simulate on healthy cartilage....a wide range of mechanical loading, simulating normal events such as moderate exercise and sharp impact events such as sports injuries....The researchers observed the response of the cartilage—growth or degeneration—and found it to be similar to that found in investigations of osteoarthritis using animal models. This gives researchers a clinically useful tool, complementing animal and human studies'..." . . . The Graduate Student Council at MIT presented a Graduate Teaching Award to **Robert Gallager**, SM '57, ScD '60, a Course VI professor. One student who voted for Gallager was quoted as saying: "he is, quite simply, the best lecturer I have found at MIT." . . . **Anita Flynn**, '83, SM '85, and **Joseph Jones** '75 (VIII), SM '77, are authors of *Mobile Robots: Inspiration to Implementation* (A.K. Peters, Ltd., 1993). . . . **Donald A. Norman**, '57, author of *The Design of Everyday Things*, has a new book: *Things That Make Us Smart* (Addison-Wesley, 1993). In his latest book, Norman "explores the complex interaction between human thought and the technology it creates, arguing for the development of machines that fit our minds, rather than minds that must conform to the machine," states a book jacket blurb. . . . **Stewart W. Wilson**, '60, SM '62, PhD '67, Jean-Arcady Meyer, and **Herbert L. Roitblat** are the editors of *From Animals to Animals 2: Proceedings of the Second International Conference on Simulation of Adaptive Behavior* (MIT Press, 1993). There are more than 60 contributions to this edition by researchers in ethology, ecology, cybernetics, artificial intelligence, robotics, and related fields, investigating behaviors and the underlying mechanisms that allow animals and, potentially, robots to adapt and survive in uncertain

environments. Wilson is a scientist at the Rowland Institute for Science in Cambridge.

Edward A. Zukowski, SM '63, of Hopewell Junction, N.Y., died on May 2, 1993. Zukowski was an electrical engineer for IBM in East Fishkill, N.Y., since 1963. He was a member of the IBM Quarter Century Club. . . . The Association of Alumni and Alumnae has been notified of the following deaths: **Winfield W. Evans**, SM '50, of Oklahoma City, Okla., on September 24, 1989, and **John R. Maull**, '37, of Leonia, N.J., on March 18, 1993. No further information was provided.

VI-A INTERNSHIP PROGRAM

Many of you VI-A'ers who went through the graduate phase of the program had contact with Professor **Campbell L. Searle**, SM '51, department graduate officer. He was especially helpful to me when I began my directorship of the program in deciding how to hasten the process of notifying VI-As of their early admissibility to the graduate school so they could better arrange for the third and fourth (graduate) work assignments to provide SM thesis material. Professor Searle retired on June 30, 1993, having served the Department successfully for 45 years. He expects to continue some of his auditory research in RLE. We thank him for his concern for VI-A and wish him Godspeed in the years to come.

Graduation, along with its end-of-term honors and awards, has come and gone as I write in mid-June. Course VI Adjunct Professor **Butler W. Lampson** was elected to the American Academy of Arts & Sciences.

Dean of Undergraduate Education & Student Affairs **Arthur C. Smith**, formerly in charge of this department's graduate office when many of you passed through, was named an Honorary Member of the MIT Alumni/ae Association. The award recognizes individuals who, though not graduates of MIT, have shown "great dedication, commitment, and loyalty to MIT and its alumni/ae." I know how much this award means; as many of you will remember, I too was similarly honored in 1985.

Let me enumerate other honors relating to VI-A of which I've become aware. The engineering honor society, **Tau Beta Pi**, elected 204 from the School of Engineering, of which 30 were VI-As. Two of their nationally chosen Laureates were from our chapter—a first in as long as I can remember: **Roderick D. Trantum**, '93, from Course VI, this year's chapter president, and the other, **Roy L. Rasera**, '93, earned bachelor's degrees in from Course III-B and XXI.

The Electrical Engineering National Honor Society, **Eta Kappa Nu**, elected 119 from the Department, of which 55 were VI-As.

The Phi Beta Kappa chapter chose 45 seniors for membership; of these 13 were single or double majors in VI, and of this group four are VI-As: **Thomas C. Chou**, '93, **John DeSouza**, '93, **Arvind K. Narayana**, '93, and **Christine L. Tsien**, '93, SM '93. De Souza was also this year's recipient of the 1993–94 Boese Foundation Fellowship.

Of three '92–'93 Institute Writing Prizes awarded in the poetry category, one went to VI-A'er **Scott Velazquez**.

An Institute Straight "T" Award (highest award for athletic performance given in individual sports) went to VI-A'er **James H. Bandy** for swimming.

This year's Annual EECS Awards Social was held in the "The Great Hall" at Quincy Market on May 16. Professors **Paul Penfield, Jr.**, ScD '60, **Fernando J. Corbató**, PhD '56 (VIII), and **Jeffrey H. Shapiro**, '67, SM '68, EE '69, PhD

'70, presided. VI-As honored included **Neil H. Tender**, '93, Special Recognition Award, for his modernization of the 6.004 curriculum and his outstanding teaching and interest in students; **Allison M. Marino**, '94, one of three **Robert M. Fano UROP Awards** (named for **Robert M. Fano**, '41, ScD '47); and **Benjamin Van Roy**, '93, one of three **George C. Newton Undergraduate Laboratory Prizes** (named for **George C. Newton**, '41, ScD '50).

Had a nice chat with Professor **Markus Zahn**, '68, SM '68, EE '69, ScD '70, who is back from his sabbatical in Grenoble, France. Markus was at a national laboratory (CNRS—Centre National de la Recherche Scientifique) where he was affiliated with the Laboratory for Electrostatic & Dielectric Materials.

Sadly report the death of **Wayne P. Stevens**, '66, SM '67, who died of cancer on May 22, 1993.

I had a nice visit from **Andrew J. Viterbi**, '56, SM '57, when he was here for a meeting of the department's visiting committee, on which he serves. Subsequently I've learned that he has been honored with the prestigious **Albert Einstein Award** from Technion (Israel Institute of Technology), awarded at a gala ceremony in San Diego.

Graduation brought several of my advisees in to visit. **Richard S. Grinnell**, '93, SM '93, who is to stay in the area and work for PictureTel, came by for lunch. . . . **Harold Y. Hwang**, '93 (VIII), '93, SM '93, who has been admitted to Princeton University to study for a PhD in physics this fall, came by with his family. . . . **Karl Sun**, '93, SM '93, who will be attending Harvard Law School in the fall.

Technology Day, June 4, brought a record 3,000 attendees. VI-As I met were **James T. Carlo**, '68, SM '69, EE '70, PhD '73, and **Michael J. Marcus**, '68, ScD '72, and his wife, **Gail**, '68, SM '68 (VIII), SM '71 (XXII). Under class listings on the Kresge bulletin boards, although I didn't meet them, were VI-As **William E. Northfield**, '56, SM '57, and **Peter M. Santeusano**, '79.

Visitors signing our "guest book" since last writing included **Arthur C.M. Chen**, '61, SM '62, PhD '66, who came by for a special visit while in the area from G.E. in Schenectady, N.Y., where he lives and works; **Adel M. Malek**, '88, SM '88, who lives in Weston, Mass.; **Michael P. Niles**, '90, SM '91, of Sunnyvale, Calif.; and **Jack A. Raymond**, '59, of Indianapolis, Fla.

In the July 1993 *Technology Review*, my column should have read that **Jay W. Van Dwingelen**, '74, was affiliated with **IRIS The Interactive System** in Kirwood, Mo. (and not Mont.).—**John Tucker**, director (emeritus), VI-A Internship Program, MIT, Room 38-473, Cambridge, MA 02139.

VII BIOLOGY

Nikki Levin, PhD '93, is in the midst of a postdoctoral fellowship at the University of California/San Francisco. . . . **Stuart H. Orkin**, '67, professor of pediatrics at the **Howard Hughes Medical Institute** in Boston, has been elected a Fellow of the American Academy of Arts and Sciences.

The American Society for Biochemistry and Molecular Biology (ASBMB) has named **Richard C. Mulligan**, '71, as the first recipient of the ASBMB-Amgen Award. Mulligan, a Course VII professor, is also a member of the **Whitehead Institute for Biomedical Research**. The award was established to recognize "significant achievement in the application of biochemistry and molecular biology to the under-

standing of disease." Nominees must be within 15 years of receipt of their PhDs. Mulligan is a leader in the development of new technologies for transferring genes into mammalian cells. Scientists use his specialized vectors (modified viruses capable of carrying tiny bits of foreign DNA) in clinical studies of gene therapy, in cancer research, and in laboratory experiments to unravel basic questions about human development. Recently, Mulligan and his associates identified a promising ingredient for cancer vaccines using a new viral vector that is more versatile and efficient than any of its predecessors. In animal studies, the novel vaccine candidate stimulated potent, long-lasting, and specific anti-tumor immunity. The Mulligan laboratory also is using the new vector for ongoing studies of blood cell development. The ultimate goal of this work is to make gene therapy a more practical alternative for patients with life-threatening genetic diseases. The award consists of a personal award of \$5,000, an unrestricted research grant of \$20,000, and a plaque. Mulligan also gave a plenary lecture entitled "Retroviral-Mediated Gene Transfer: Basic and Practical Applications" at ASBMB's annual meeting last May.



Ihor Lemischka

Ihor Lemischka, PhD '83, has been promoted to the rank of tenured associate professor of molecular biology at Princeton University. Lemischka joined Princeton in 1986 as an assistant professor after postdoctoral study at MIT's Center for Cancer Research and the Whitehead Institute for Biomedical Research. He studies

mammalian hematopoiesis (blood formation). **Joseph Franklin, MPH '42**, of Brookline, Mass., died on May 5, 1993. While serving as a captain with the Army's 428th Field Artillery Group from 1942-46, Franklin earned the American Service Medal as well as the Army of Occupation Medal for the Italian Campaign. After the war Franklin earned an MD at Boston University School of Medicine. In addition to operating a private practice from 1954-86, Franklin worked on the staff of many hospitals, including Boston City Hospital, Faulkner Hospital, and the Boston University Hospital. Franklin was an advisor to the Social Security Administration regarding disability policies. For years he taught Social Security judges the medical framework on which they based their decisions.

VIII PHYSICS

From Woodstock, Md., **Ralph L. McNutt, Jr., PhD '80**, reports: "On May 26, I reported on recent inferences about the distance to the heliopause at the meeting of the American Geophysical Union in Baltimore. I also gave (with Professor D. Gurnett of the University of Iowa) a press conference on this subject. It was reported on the front page of the *New York Times* on May 27 and has also been covered by other newspapers." ... **Francesco Iachello, PhD '69**, the J.W. Gibbs Professor of Physics at Yale University, has been awarded the prestigious 1993 Tom W. Bonner Prize by the American Physical Society for accomplishments in nuclear physics research. The prize was estab-

lished in 1964 to "recognize and encourage outstanding experimental research in nuclear physics, including the development of a method, technique, or device that significantly contributes in a general way to nuclear physics research." Iachello shares the prize with Akito Arima of the University of Tokyo. The two physicists developed the Interacting Boson Model in the 1970s to describe the structural and collective properties of spherical, transitional, and deformed nuclei, which has become an essential bridge between the nuclear shell model and the liquid drop model of collective nuclear motion. ... **Murray Gell-Mann, PhD '51**, the Robert A. Milikan Professor of Physics at Caltech, has been elected a member of the American Philosophical Society (APS). APS was founded by Benjamin Franklin and is the nation's oldest general learned society. ...

Albert D. Wheelon, PhD '52, has been elected to the Rand board of trustees in Santa Monica, Calif. Wheelon spent 22 years as a senior executive with Hughes Aircraft Co., retiring as chair and CEO in 1988. Prior to joining Hughes, he was deputy director of the CIA for science and technology. He has also served on the Defense Science Board, the President's Foreign Intelligence Advisory Board, and the Challenger accident commission. ... **David A. Kessler, '76**, of the Food and Drug Administration, has been elected a Fellow of the Institute of Medicine. With their election, members make a commitment to devote a significant amount of volunteer time on committees engaged in a broad range of studies on health policy issues. Current institute projects include the identification of measures to strengthen U.S. dental education, and the issues and implications of tests used to detect genetic disorders. ... **Joseph Jones, '75, SM '77**, and **Anita Flynn, '83, SM '85 (VI)**, are the authors of *Mobile Robots: Inspiration to Implementation* (A.K. Peters, Ltd., 1993).

Edward B. Cooper, '40, of Newark, Del., died on April 13, 1993. From 1931-42, he taught high school science in Orono, Maine, and Brookline, Mass. He joined DuPont in 1942 as a supervisor of the physics group doing research in the plastics department at the Arlington, N.J., plant. He was transferred to the Experimental Station in Wilmington in 1950 as senior supervisor of the polymer products department. In the 1960s, he was named laboratory director of the department and later worked in the patent department and as manager in human resources. Cooper retired in 1973 and served as a consultant to DuPont and W.L. Gore & Associates until 1993. He was a member of the Newark Lions Club for more than 40 years, serving as its president in 1964. ... The Association of Alumni and Alumnae has been notified that **Marshall Walker, '46**, of Chaplin, Conn., died on October 29, 1989. No further information was provided.

IX BRAIN AND COGNITIVE SCIENCES

Janet L. Conway, PhD '81, has been named director of product development at VIMRx Pharmaceuticals, Inc., in Stamford, Conn. Previously, she was clinical regulatory affairs manager at the Olympus Corp. in New Hyde Park, N.Y. ... **Mary Brown Parlee, PhD '69**, the Tallman Visiting Professor in Women's Studies at Bowdoin College in Brunswick, Maine, recently presented the 1993 Tallman Lecture at Bowdoin. Her talk was entitled "Premenstrual Syndrome: A Case Study in the Construction of Scientific Knowledge." Parlee is professor of psychology at the Graduate Center of the City University of New York, and is a former direc-

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M. Walbaum, SM '88

tor of the Center for the Study of Women and Society at The City University of New York. She has also taught at Barnard College and Wellesley College. Parlee serves on the Ms. Magazine advisory board of scholars and is a former associate editor of *Psychology Today*.

X CHEMICAL ENGINEERING

John T. Day, ScD '72, has been named president and CEO at Mining Services International Corp. Previously he was director of engineering and new business development at Irecto Chemicals. Both companies are in Salt Lake City,



Arthur Metzner

Utah. . . To mark his 40th anniversary at the University of Delaware, **Arthur B. Metzner, ScD '51**, the H. Fletcher Brown Professor of Chemical Engineering, was honored with a symposium held in his name. Leaders from universities and major companies around the world joined in the celebration. Metzner joined the university faculty

in 1953 and has held his current professorship since 1962. From 1970-77, he chaired the Department of Chemical Engineering. He is world renowned for his research in the flow of non-Newtonian fluids or rheology, and has published many pace-setting results with his students. He continues to lecture nationally and internationally and is currently the editor of the *Journal of Rheology*. Metzner's many awards and honors include a Guggenheim Fellowship at the University of Cambridge.

Francisco Camps Campins, ScD '33, of Pelham, N.Y., died on April 7, 1993. Camps Campins was founder and CEO of Polymer Industries in Stamford, Conn., and retired in 1969 as chair of the board. He was recognized by the Packaging Institute for professional achievements and accomplishments. He was also granted the Technical Contribution Award from the U.S. Army, Natick Labs, in Massachusetts. . . **John Stuart Patterson, SM '33**, of Schenectady, N.Y., died on May 21, 1993. He was a chemical engineer at American Cyanamid for 38 years, retiring in 1976.

X-A PRACTICE SCHOOL

Readers of this column will remember that Carol Phillips won the Practice School's first "Mother Award" a year ago for her constant help to its students. Her efforts have not diminished: as this column's official reporter at the department's private celebration after Commencement on May 28, she talked to no fewer than 26 SCEP alumni/ae. Here's her report:

Six of the 14 who had just received SMs in Course X-A are still at MIT working on doctorates: **Jonathan Allen, Erik Hancock, Angelo Kandas, Michael Kwan, Radya Nayak, and Hongbin (Dai) Ni**. **Colleen Kelly** is continuing at MIT, too, but with a difference: she took time off to be married at home in Ocean Springs, Miss., on June 5. Of the others with whom Carol talked, **Vivek Dodd** is taking time off from graduate work, which he'll eventually complete at MIT, to be assistant director at the West Point Station (Merck) for 1993-94. **George Alexopoulos, '92**, was soon to leave for

England, where he's working as a financial analyst for Bankers Trust Co. **Dominic Rodrigues**, who always complained while attending SCEP that "I'll never be an engineer—I'm a finance person," came from London to pick up his MIT degree and was about to receive a second master's from the London School of Economics. But Dominic confessed to Carol that "finance is not for me" after all, and he was hoping for a job in environmental engineering in Canada. **Ridwan Rusli** also made a long trip to collect his SM diploma: he's working at Lurgi in Frankfurt, Germany, and wants to return to Indonesia by 1994. As already reported, **Ashley Shih** is working at Amoco in Chicago. **Tina Srivastava** looked forward to going home to work with Exxon Chemical in Singapore. And **Xinjin Zhao**, back from his job at W. R. Grace, in Columbia, Md., reported that he and his wife were expecting their first child in August.

Eleven SCEP alumni/ae were on hand to receive PhDs. **Fred Armellini, SM '87**, is working at Arco Chemical in Newtown Square, Pa. For **Gordon Craig, SM '89**, it's a move to California for a new job at Raychem in Menlo Park. It was a long trip for **Timothy Donahue, SM '87**, who vacationed from his work at Mitsubishi Kasai, Yokohama, Japan. **William Haulbrook, SM '91**, planned to start during the summer as a research engineer with Michelin Tire—location not specified at press time. **Dawn Renee Orton, SM '87**, returned for Commencement from La Jolla, Calif., where she works at Advanced Tissue Sciences. And **Bruce Scruggs, SM '88**, is continuing at MIT—a post-doc with Professor Karen Gleason (chemical engineering). Future plans were uncertain as of Commencement for **Sarakorn Gerjarusak, SM '90**, and **Vishak Sankaran, SM '90**. And we've already reported in recent issues on **Joanne Liu, SM '88** (Cabot Corp., Billerica, Mass.), **Thomas Meadowcroft, SM '90** (director of the West Point Station), and **Joy Mendoza, SM '89** (Hass and Rohm). **Gordon Smith, SM '90**, came back from 3M in Minneapolis to receive an ScD.

A. David Rossin, SM '55, notes that he ended his one-year term as president of the American Nuclear Society last June 25. He's had a long and distinguished career as a manager and advocate of nuclear power.

Back from his winter home in North Palm Beach, **William C. Rousseau, SM '36**, shared with us his annual newsletter—a composite of reports collected from them circulated to classmates—a labor of love since his graduation from SCEP. For himself, Bill describes his treatment for prostate cancer (uneventful) and his continuing assignments and enthusiasm for the Practice School. Other highlights: in his annual contribution, **George Akin, ScD '35**, describes his birthday celebration: "One is forced to leave out quite a few things when experiences of 80 years are compressed into 15 minutes," he says. He was asked if he regretted working on the atomic bomb that destroyed Hiroshima and remarks, "The young people do not realize the difference between World War II and the wars in Vietnam and Iraq." . . . From Austin, Tex., **George Cummings, SM '36**, writes that he, like many of the rest of us, considers he is "too busy puttering around. [But] life continues to be good to me." . . . From John Demo, '35, SM '36 (writing last November), "I intend to ignore the presidential choices and vote for every woman on my ballot. The men have made a terrible mess of government. A little stirring of the pot is much overdue." . . . Writing just after the election, **W. Frank Lenoir, SM '36**, confesses his uneasiness at the outcome: "I presume we shall survive this new regime as we have in the past. I shall expand my catfish farm, so we'll at least have something to eat!" . . . **Robert C. Gunness,**

SM '34, ScD '36, reports his pleasure at the dedication of the Guinness Engineering Student Center at the University of Massachusetts in May 1992. . . . **John Roberts, SM '36**, enthused about the museum/concert hall complex in Melbourne, Australia, which he and his wife had just visited: "superbly planned integration of engineering and design features."

From Professor **Jefferson Tester, PhD '71**, who was director of the Oak Ridge Station and later of SCEP, we learn that **Alice Maxwell** will be in Russia as this issue of the *Review* is published—a two-week mission organized by the Central Baptist Church of Oak Ridge. Thirty members of the congregation are making the trip. Maxwell was its secretary through the entire life of SCEP's Oak Ridge Station from 1966-82—a very special person to the many students and staff who worked there.

A return for the forthcoming 1994 edition of the MIT Alumni/ae Register reports the death on March 3, 1993, of **William C. Black, SM '34**, in Cedar Rapids, Iowa. He had a long association with Penick & Ford, Ltd., producers of corn oil and other agricultural products in Cedar Rapids.—**John Mattill, Technology Review, MIT, Room W59-200, Cambridge, MA 02139.**

XI URBAN STUDIES AND PLANNING

From Sudbury, Mass., **Gregory Sobel, MCP '88**, writes: "I am now serving as staff environmental mediator with the Massachusetts Office of Dispute Resolution. I am the senior associate in the Environmental Mediation Program and have designed state agency mediation projects for hazardous waste cleanup and for development of disputes in environmentally sensitive areas. These are the first programs of their kind in the United States. I have just returned from my third trip to Russia, where I taught mediation skills and participated in seminars regarding applications of mediation to environmental and interethnic disputes in the former Soviet Union." . . . **Marie I. Howland, PhD '81**, writes: "I am director of the Urban Studies and Planning Program at the University of Maryland at College Park." . . . **Jamie Fenwick, PhD '76**, sends word from New York City: "After graduation I worked for a year as an assistant to a federal cabinet minister in Canada (first culture and then science & technology). I 'retreated' to Tunisia for a year and then spent three years in New York City with the Dance Notation Bureau raising money and helping to manage the bureau. (DNB promotes a written language for dance). Then two years of healthcare consulting followed by four years as deputy director of the New York City Commission on the Year 2000. This look at the future of New York was well received and is, surprisingly, still referred to after four years. Then four years of 'underemployment' and consulting, principally around the transportation and economic development issue of rail transit to La Guardia and JFK airports. The line now looks as if it will be built. Both parents died and the family summer home burned down within a two-year span; the house was rebuilt and life goes on." . . . **Juan A. Brando-Pradilla, '83**, reports: "I am president of Urbana Architects and Planners in Bogota, Colombia. It is an architecture and design firm offering an integrated service in urban design, interior design, and landscape architecture, whose major works have been developed in Colombia, with plans to open branches in Caracas and other major cities of Latin America." . . . From Washington, D.C., **Hershel Lipow, SM '90**, sends word: "I am now a pro-

ject manager at ICF, Inc., working on affordable housing contracts as a consultant to HUD and state and local governments. I was previously president of MUSCLE, Inc., a nonprofit housing developer in Washington, D.C." . . . **Deborah W. Poodry**, MCP '79, MAA '79, has been named VP for planning at Wallace, Floyd Associates, Inc., in Boston. . . . **Sheryl L. Handler**, PhD '85, has been named chair and CEO at Thinking Machines Corp. Previously she was president of the Cambridge-based firm. . . . **Michael Giaimo**, MCP '85, has been elected to the planning board of the city of Sherborn, Mass. Giaimo, an attorney in land-use and environmental law with Rackemann, Sawyer, & Brewster, has lived in Sherborn for two years, where he has also recently been appointed to the Geograph Information Systems Committee. . . . **Shirley Mark**, MCP '90, has been elected to the statewide board of directors of the Massachusetts Society for the Prevention of Cruelty for Children (MSPCC). MSPCC, one of the oldest non-profit child welfare agencies in the country, has since 1878 provided services to treat and prevent child abuse and neglect through a statewide network of regional offices. The 55-person board of directors is actively involved with MSPCC policies and fund-raising activities that advance the mission of the agency. Mark is the director of the Commission to Study Racial and Ethnic Bias in the Courts for the Massachusetts Supreme Judicial Court. Throughout her career, Mark has worked on issues concerning diversity and discrimination through organizations such as the Asian American Resource Workshop, the Anti-Defamation League, and The Multicultural Project. She is currently on the board of the Asian American Resource Workshop. . . . **Omar Razzaz**, MCP '87, a Course XI visiting lecturer, has been presented

with a Graduate Teaching Award by the Graduate Student Council. Graduate students cast votes for their favorite professor and one award is presented in each of the five schools at MIT.

Gordon G. Robeck, SM '50, of Laguna Hills, Calif., died on February 21, 1993. Robeck, who worked for the EPA and the U.S. Health Service, pioneered research in the use of granular-activated carbon for drinking-water treatment, a technology currently being used at the Cincinnati Water Works, which has the world's largest such facility. In 1985 he retired as director of EPA's drinking-water research division in Cincinnati. Robeck served on numerous boards including the American Water Works Association and the National Research Council. He was a member of the National Academy of Engineering and a consultant on water-supply issues. He served for many years at the Robert A. Taft Sanitary Engineering Center in Cincinnati and as a commissioned officer in the U.S. Public Health Service.

XIII OCEAN ENGINEERING

From Waltham, Mass., **Madan Venugopal**, SM '87, writes: "After four years away from MIT (since 1989) working as an applications specialist at Multiflow Computer, Alliant Computer Systems, and Digital Equipment Corp., I am coming back to finish a PhD in the Ocean Engineering Department. I am looking forward to returning to MIT and a full-time student life." . . . Lieutenant Commander **Matthew Sharpe**, OCE '90, sends word: "I have been assigned as reactor training assistant in USS *Enterprise*, now being refueled at Newport News (Va.) Shipbuilding and Drydock Co. I am responsible for training and qualifying over

800 nuclear-trained enlisted men and officers. Overhaul of this fine warship and her eight reactor plants is quite an adventure. My wife, Carole, and daughters, Lauren and Camille, will join me here soon." . . . **Albert F. Suchy**, SM '80, OCE '80, reports from nearby Waltham, Mass.: "I recently completed my tour as commanding officer of the U.S. Coast Guard Naval Engineering Support Unit in Boston. I loved the job and will miss it. I left the job a year early because of the opportunity to participate as a '93-'94 Sloan Fellow. We started June 18, 1993. My three children helped me unload the trunk of my car with all the books for the summer semester. Right about now I'm wondering which end's up! They say things get better by Christmas. Ah, it's great to be back in school." . . . **Lawrence K. Donovan**, SM '71, writes: "Judi and I have been relocated from the Washington, D.C.-area back to San Francisco by Bechtel. I am now the manager of operations for Bechtel National, Inc., which includes projects in advanced systems, nuclear operation, and their entire environmental business."

After serving 34 years as an officer in the Coast Guard, **David Flanagan**, SM '62, NE '62, has established himself in a second career, that of an internationally acclaimed "Bamboo Fencer." Flanagan and his art were featured in a May 1993 article in the *Jamaica Plain/Roxbury Citizen*. In the piece Flanagan claims his art, which has been featured in catalogues and on T.V., was inspired when he served as the chief of navigation in Panama. "Surrounded by bamboo, Flanagan began fashioning decorative planters made of the exotic grass. . . . Flanagan pursued the study of bamboo and traveled to Latin America where he noted the devastation of the land after defoliation. The journey resulted in an environmental discovery as Flanagan found that planting bamboo was an

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excellent restorative method to reinvigorating the soil. Bamboo has excellent leaf-fall, its rhizomes hold the soil, he explained." Flanagan now employs three full-time workers in his Jamaica Plain, Mass., studio. In addition to fences and planters, they make indoor panelling and other decorative objects. Flanagan's work has been featured on PBS' *Victory Garden*.

Alan C. McClure, SM '50, of Houston, Tex., died on May 1, 1993. He served in Europe in the U.S. Army infantry during WWII and was awarded a Bronze Star. His career began in 1950 at the Electric Boat Division of General Dynamics Corp. in Groton, Conn., where he was involved in developing the first nuclear-powered submarines. He then moved to Houston and worked at Brown and Root as chief naval architect on Project Mohole, funded by the NSF. Mohole was an advanced program whose objective was to probe deeply into the earth's crust, thereby expanding the frontiers of technology for deepwater drilling and sampling of the ocean floor. It was during this time that the early development of the semisubmersible concept for a stable working platform was evolved. This technology and its applications are the basis for the large semisubmersible drill rig fleet operating today. In 1967 McClure joined Continental Oil and spent the next five years applying naval architecture and marine engineering to offshore production problems. This led to his being an independent consultant with his own firm, Alan C. McClure Associates, Inc., established in 1975. The company developed small-waterplane-area twin-hull (SWATH) vessels. In 1987 McClure was awarded the Blakely Smith medal by the Society of Naval Architects and Marine Engineers. He was a Fellow of the Society, a Life Member, and had held several national offices. . . . Commander Elbert F. Durfee, Jr., '51, of York, Maine, died on May 12, 1993. For 20 years he served in the Navy as an architect, retiring from the Portsmouth Naval Shipyard. Durfee worked at General Dynamics for 18 years in Groton, Conn. He was a volunteer of the Meals on Wheels organization and received the faculty award for volunteerism from Wells High School, as well as the Governor's Medal for Drug and Alcohol Education.

XIV ECONOMICS

Stephen Goldfeld, PhD '63, writes: "I have jumped from the frying pan into the fire, as I am about to give up the chairship of the Department of Economics to become the provost at Princeton University. I will now be one step removed from fending off the habitual raids by the MIT department." . . . Kathleen F. Feldstein, PhD '77, president of Economic Studies, Inc., in Belmont, Mass., has been named to the board of directors at Digital Equipment Corp. in Maynard, Mass. . . . Philip Kotler, PhD '56, writes to alert us to two books he has written: *Marketing for Congregations: Choosing to Serve People More Effectively* (Abingdon Press, 1992); coauthors are Norman Shawchuck, Bruce Wrenn, and Gustave Rath. The second book, *Marketing Places: Attracting Investment, Industry, and Tourism to Cities, States, and Nations* (The Free Press, 1993), was cowritten by Donald H. Haider and Irving Rein. . . . Jean M. Tirole, PhD '81, of the Université de Toulouse in France, has been elected a foreign member of the American Academy of Arts and Sciences. . . . George P. Schultz, PhD '49, has written *Turmoil and Triumph: My Years as Secretary of State* (Charles Scribner's Sons, 1993). In the book's foreword, Shultz

writes that when he "started as secretary of state, the world was in turmoil, and when I left office, the cold war was over and, after a struggle lasting over four decades, the idea of free and open political and economic systems had triumphed." . . . Peter Temin, PhD '67, has been selected as the Elisha Gray II Professor at MIT. Temin, head of the Economics Department since 1990, has done research on a range of subjects, including the market structure of the U.S. pharmaceutical and telecommunications industries, the economic impact of slavery on the antebellum and postbellum South, and business cycles, panics and depressions. . . . Also at MIT, Paul R. Krugman, PhD '77, has been selected as the Class of 1941 Professor. Krugman has been a leader in applying recent insights in the theory of industrial organization to international trade. These new models explain how the same goods can be both exported and imported by a single company, how trade is affected by the market power of firms, and why similar countries trade with each other. He has also made many contributions to the theory of currency crises and exchange rate changes. In 1991 he received the John Bates Clark Medal from the American Economic Association as the economist under 40 who has made the most important contributions to his field.



Robert Vishny

Robert Vishny, PhD '85, has been named the Eric J. Gleasher Professor at the University of Chicago's Graduate School of Business. Vishny's research focuses on the behavior of institutional investors, the economics of rent-seeking behavior, and the corporate capital structure. He is the author of numerous articles on socialist economies and the

money-management industry. He is the director of the Program in Corporate Finance for the National Bureau of Economic Research and is a director of the American Finance Association. Vishny is associate editor of the *Journal of Finance* and the *Journal of Financial Economics*. He has been a member of the business school faculty since 1985.

The Association of Alumni and Alumnae has been notified of the following deaths: David P. Heffernon, '42, of Rockford, Ill., on February 27, 1991, and Mabra G. Abernathy, '42, of Columbia, S.C., on June 5, 1980. There was no further information provided.

XV MANAGEMENT

Raymond Clarke, SM '85, writes from Arlington, Va.: "In July 1992 I moved from SPA/Mercer to Metpath, a \$1-billion subsidiary of Corning that runs a network of clinical testing laboratories. I am working with the CEO to get the company in shape to deal with the changes in the health care industry. My wife, Carole Clarke, SM '85, is still at Marriott, as senior director of strategy and quality for the senior living services business. We now have two girls, Alison, 4, and Lauren, 1." . . . From New South Wales, Australia, Doug Dodds, SM '58, reports: "I am retiring this December after teaching calculus and analytic geometry to engineering and science students at the University of Technology at Sydney for the last 13

years. Management education in Australia is on a sound basis with nearly all 41 universities in this country having graduate schools of management. Regards to all at Sloan." ... **Carlos Mateo**, SM '89, sends word: "Our family has successfully transferred with Procter & Gamble from Puerto Rico to Guatemala (P&G office for Central America). Roxanna, Maria Jimena, 4, Anne Gabriela, 2, and I are still adjusting to the trade-off of being back in the developing world after six years in the U.S. We are also expecting a new member of the family in August '93. I'm responsible for the whole P&G business in my native country, Costa Rica, and for the shampoos, papers, and toilet soaps in Central America." ... From Naples, Italy, **Carolina Botti**, SM '91, reports: "One of the things you continue to appreciate after graduation when you are back in your country to work, is that you have friends all over the world. It has been nice: rubs recently to get together with **Yoko and Charles Akiha**, SM '91, as well as some of the Italians: **Stefano Roscini**, SM '91, **Matteo Caroli**, SM '91, and **Giovanni Abramo**, SM '90." ... **Chris Bohrsen**, SM '84 and **Kathy Kasper Bohrsen**, SM '84, write: "We are still living in Singapore where our daughter, Michelle, was born on March 1. Chris manages Teradyne's business in Asia. For the time being, Kathy stays home with Michelle and her older brother, Craig, who is almost 2." ... **Donald L. Barefoot**, SM '78, is president of the Chromalox Division at Emerson Electric Co. in Pittsburgh, Pa. ... **Mike Jimenez**, SM '77, is a controls manager at Exxon Engineering Co. in Houston. He writes: "Project management assignment in Houston for Natuna Gas Project in Indonesia. Daughter, Lila, is now a sophomore at Vanderbilt University." ... **Paul E. Appleby**, SM '87, lives in East Hanover, N.J. He sends word: "I am a portfolio manager for Prudential Insurance in Newark, N.J." ... **Michael De Marco**, SM '68, reports: "I moved to Connecticut last year to join the GTE Investment Management Corp. as director of investment research. We are now living in Old Greenwich with the kids attending Greenwich High and Eastern Middle Schools." ... **Mike Sambor**, SM '83, is senior information specialist at The Travelers Companies in Hartford, Conn., and writes to us from Wilbraham, Mass. "Professional: I'm currently working with a team to define benchmarking criteria for application systems, hopefully to be used by all businesses within the corporation. Hobbies: Over the last four years, I have reached some personal goals such as: singing solo as part of a choral club (Travelers Choral Club) and winning a chess tournament (at TIC). Also mixing pleasure with social responsibility—Travelers Chess Club raised over \$500 for the United Way last year and we're aiming for more this year. On the horizon: selling insurance/financial services for TIC in Massachusetts; actuarial exams." ... **Hunt Lambert**, SM '85, sends word from Englewood, Colo.: "Our two children, Hunter (18 months) and Carolyn (5 years) are doing great. Kelly works full time as an attorney and recently skated on two teams at the USFSA National Championships in Detroit. I continue to do market strategy development for U.S. West and am happily living back in Denver after two years overseas. Please call to catch up at 303-689-8547!" ... **Keith E. Camhi**, SM '91 (XV), SM '91, reports: "I have been helping with the manufacture of a custom computer for use by Bloomberg Financial Information Services. And I'm starting a company to provide computer services to the fitness industry." ... **Mark Jrolf**, SM '92, writes: "I have recently become engaged to Tess Meyers. I am currently a Robert Bosch Foundation Fellow,

living in Berlin. As a Bosch Fellow, I have been working on industrial policy and privatization matters in the Economics Ministries of the German federal government in Bonn and the Brandenburg State government in Potsdam. This fall I will join McKinsey & Co. in Washington, D.C." ... Four baby girls have been born to alumni/ae. **Emily Shames**, daughter of **Jeff Shames**, SM '83, arrived May 31, 1993, and **Nina Schatz**, daughter of **Dave Schatz**, SM '83, was born the day of the 10th reunion, June 5, 1993. **Leslie Schine**, SM '77, and **Nils Nilsen** announced the birth of their daughter, **Cody Gildersleeve Nilsen**, on April 5, 1993, and **Marla Choslovsky**, SM '88, and **Paul Greenberg**, SM '88, also announce the birth of their daughter, **Talia Greenberg**. Born on October 12, 1992, Talia's birth announcement arrived on a baseball card which dubbed her "Rookie of the Year," complete with important stats. ... **Mark Atkeson**, SM '91 (VI), SM '91, has been given an Outstanding Achievement Award for Extraordinary Leadership/Management Effectiveness and Outstanding Contribution to the Corporation or a Business Unit at United Technologies (UTC), where Atkeson is a research engineer in product development and manufacturing. Atkeson "played a key role in helping UTC establish rapid prototyping programs in Italy and Spain. The programs will help UTC's European operations to quickly and cost-effectively produce prototype parts. Atkeson worked with the European units to identify technical needs, educate users, perform pilot projects, and plan collaborations and investments. He also helped write a proposal that netted a \$1 million funding award for rapid prototyping research," according to *The Researcher*. ... **Jeffrey F. Moy**, SM '86, has a new title at Staples, Inc., in Framingham, Mass. He is now marketing manager and previously was with the international joint venture projects group.



Robert Hamada

Robert Hamada, SM '61, PhD '69, the Edward Eagle Brown Distinguished Service Professor in the University of Chicago Graduate School of Business (GSB) has been named dean of the school. Hamada has been a member of the Chicago faculty since 1966. An internationally known authority in finance, he teaches courses in corporate finance and corporate strategy, and serves as director of the school's Center for International Business Education and Research. Hamada was deputy dean for faculty at the GSB from 1985-90 and served as director of the school's Center for Research in Security Prices from 1980-85. He received the first outstanding teaching award given by the GSB in 1970, and the school's McKinsey Award for excellence in teaching in 1981. In 1982 he was named one of the eight outstanding business school professors in the United States by *Fortune* magazine. Hamada recently completed a four-year term as a public director of the Chicago Board of Trade and has served on the board of directors of the American Finance Association. He has been an associate editor for both the *Journal of Finance* and the *Journal of Financial and Quantitative Analysis*. He currently serves as a director of several organizations including the National Bureau of Economic Research. His research interests include the effects of risk and taxes on the financing and capital budgeting decision of

companies, on portfolio selection, and on the pricing of capital assets. He has also analyzed the connection between finance, corporate strategy, and international business. In addition to his expertise in finance, Hamada is also a specialist in financial futures markets and current issues affecting corporate boards of directors and CEOs. ... **Peter Pavlina**, SM '92, is now senior research assistant at Keystone Custodian Funds, Inc. He was formerly an international analyst at the Boston-based firm **Paul V. Cusick, Jr.**, SM '71, has been promoted to executive VP and treasurer at Century Bank and Trust Co. in Somerville, Mass. Cusick, previously the senior VP and treasurer, will continue to oversee corporate financial management, planning, and investment decisions. ... **Patricia Callahan**, '75 (II), SM '77, has been named director of personnel and an executive VP at Wells Fargo Bank in San Francisco, Calif. Callahan is responsible for the bank's central personnel functions, including employee benefits, payroll, staff analysis, and employee relations. She started her banking career in 1977 at Crocker Bank, where she held various positions before being promoted to senior VP with Crocker Corp. Services in 1985. After Crocker's merger with Wells Fargo Bank in 1986, Callahan became manager of operations and systems for Wells Fargo's Wholesale Services Group. She managed operations and systems for the bank's Real Estate Group for the past two years before accepting her current position. ... **Bril Flint**, '83 (II), SM '86, has been appointed VP for strategic planning at EMI Records Group North America in New York City. In this position, Flint is responsible for market and competitive analysis, and acquisitions and new venture evaluation, as well as planning and long-range strategy development for the company. Since 1991, Flint has been EMI Music's senior director of worldwide strategy and planning. ... **Mark V. Matthews**, SM '87, Course XVIII assistant professor, has been selected to be the next holder of the Cecil and Ida Green Career Development Professorship. Matthews, an applied mathematician has been at MIT since 1991. He has taught subjects in probability and statistics, statistics for applications, statistical computing, and multivariate analysis.

William L. Sorensen, '33, of Peoria, Ariz., died on May 28, 1993. Warren was retired as president of the Warren Woolen Co. in Stafford Springs, Conn., and a member of several town organizations including the Stafford School Board. ... The Association of Alumni and Alumnae has been notified that **Ian R. Lounsbury**, SM '48, of Toronto, Ont., died on August 15, 1992. No further information was provided.

Sloan Fellows

James J. Howard III, SM '70, has been named to the board of directors at NWNL Companies in Minneapolis. He continues as chair and CEO of Northern States Power Co., also in Minneapolis. ... Effective December 1993, **Edward Steinhoff**, SM '71, will retire as CFO of Dow Corning Corp. in Midland, Mich. ... **Peter B. Teets**, SM '78, has been named president of the Space Group at Martin Marietta Corp. in Bethesda, Md.. Previously, Teets was president of the company's Astronautics Group in the Denver, Colo., office. ... **George H. Weyerhaeuser, Jr.**, SM '86, has been named executive VP at Weyerhaeuser Canada Ltd. in Vancouver, B.C. He moves from Weyerhaeuser Co.'s Tacoma, Wash., branch where he served as VP for manufacturing.

John G. Howard, SM '57, of Sun City Cen

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Four members of the Class of 1943, all graduates of the original Course XVII, reminisce with their erstwhile mentor, Institute Professor Emeritus Albert Dietz, '32, at the Museum of Science during their 50th Reunion last June. They had fetched him from Maine for the occasion. From left (and around the globe), they are: Eugene Eisenberg, of Boston; E.J. Tan, of Singapore; Professor Dietz; Angel Del Valle, of Puerto Rico; and Dick Feingold, of California. Since 1965, the Political Science Department has carried the designation Course XVII, but from 1929-64, Course XVII was the home of Building Engineering and Construction.

ter, Fla., died on February 1, 1993. Howard joined the AEP Service Corp. in 1948 as an assistant engineer. He was promoted through several positions from engineer in 1948 to executive VP in 1984. Howard retired in 1986. . . . The Association of Alumni and Alumnae has been notified of the following deaths: Kenneth I. Lichti, SM '61, of Ventura, Calif., on January 27, 1993; Harrison T. Price, SM '55, of Sun City, Ariz., on February 19, 1993; and Stuart A. Challenger, '35, of Lakehurst, N.J., on December 14, 1992. There were no further details provided.

Senior Executives

David E. Lowe, '87, has been named president and CEO at Chesapeake & Potomac Telephone Co. of West Virginia in Charleston. Previously, he was director of One Valley Bancorp of West Virginia, also in Charleston. . . . Thomas W. Eagar, '72, ScD '75 (III), '88 Course III professor and co-director of the Leaders for Manufacturing Program, has been elected to the board of directors at the Nashua Corp. in Nashua, N.H. . . . Barry M. Bloom, '48, PhD '51, (V) '67, executive VP for R&D has retired from Pfizer, Inc., and its board of directors. Bloom joined Pfizer in 1952 as a research chemist. He served as a research supervisor and director of medicinal products before being named president of Central Research in 1971. The same year Bloom was elected a corporate officer of Pfizer, Inc., and was elected to the board of directors in 1973. In 1990 he was named senior VP and executive VP last year. Milne joined Pfizer in 1970, progressing through several management positions in new drug discovery.

Ralph C. Holmer, '63, of Golden, Colo., died on November 15, 1992. Upon graduation

from the Colorado School of Mines (CSM) in 1938, Holmer did extensive oil exploration surveys in Iraq and Palestine. He was a physicist for the U.S. Naval Bureau of Ordnance out of Charleston, S.C., during WWII. He worked for the Standard Oil Co. of California in oil exploration across the United States. Holmer received the CSM "Distinguished Service Medal" in 1971. He was chief geophysicist for Kennecott Copper Corp. for nearly 20 years, working in mineral exploration in the U.S., Australia, New Guinea, Chile, and Peru. He began teaching at CSM in 1971 and for the next 10 years, until his retirement, teaching and research consumed his talents and energy. . . . The Association of Alumni and Alumnae has been notified of the following deaths: Chester W. Carter, '62, of Greensboro, Vt., on April 18, 1993; Asa F. Kinney, '62, of Kennebunk, Maine, on February 15, 1993; Louis Castelli, '67, of Dallas, Texas, on June 21, 1990; and David Wilson, '67, of Norwalk, Conn., on June 7, 1992. No further information was provided.

Management of Technology Program

Koichi Hagishima, SM '92, stopped by to visit MOT Program staff and attended the Class of 1993 Commencement reception, where he met graduating students. Koichi reports that many of the Japanese MOTs got together recently and greatly enjoyed swapping stories about their year at the MOT Program. . . . Hiroshi Shiroy, SM '92, was promoted to staff officer in the Planning Department in the City of Osaka Sewage Works bureau. He reports that Japan, especially Osaka, is "heading toward an awfully hot and humid period like the one we had in Boston."—MOT Program, MIT, Room E56-290, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

A.J. Cwierny, SM '67, is corporate director of technology at Northrop Corp. in Los Angeles, Calif. . . . **Joseph D. Antinucci**, SM '65, has been named president of Martin Marietta Electronics and Missiles, Inc., in Baltimore, Md. Previously, Antinucci was VP for technical operations at Martin Marietta Corp. . . . Iowa State University President **Martin C. Jischke**, SM '64, PhD '68, has been named to the board of directors of Kerr-McGee Corp. in Oklahoma City, Okla.

XVII POLITICAL SCIENCE

Vann H. Van Diepen, SM '83, of the U.S. Department of State, has been named one of 10 winners of the 45th annual Arthur S. Flemming Award for 1993. The awards recognize excellence in government service and are presented by the Downtown Jaycees in the District of Columbia. Van Diepen received his in the scientific category and was cited for his "outstanding contributions to the administration of U.S. strategic intelligence, arms control, and non-proliferation policy." A press release states: "Van Diepen served for nine years as the State Department's top expert on Soviet nuclear forces, making major contributions to U.S. policymakers' understanding. He coordinated the analysis of East-West arms control issues, developed the aircraft and manpower limits in the Conventional Forces in Europe Treaty and key limits of the Strategic Arms Reduction Treaty (START). Since the end of the Cold War, Van Diepen has led the U.S. government's working-level effort to prevent the proliferation of chemical, biological, and missile weapons. He played the key role in updating the Missile Technology Control Regime and developed the successful U.S. diplomatic strategy to secure approval of the Chemical Weapons Convention." . . . **David B.H. Denoon**, PhD '75, New York University professor, has written a critique of U.S. Far East policy entitled *Real Reciprocity: Balancing U.S. Economic and Security Policies in the Pacific Basin* (Council on Foreign Relations Press, 1993). In this, his fifth book, the professor of economics and politics, who has served in NYU's Faculty of Arts and Sciences since 1975, critically examines the United States' post-WWII experience in Asia. Denoon has held high posts in both the Carter and Reagan Administrations.

Jonathan A. Fox, PhD '86, Course XVII associate professor, has been selected to be one of the next holders of the Mitsui Career Development Professorship. Fox has teaching and research interests in democratization, public policy, and social movements in developing countries, sustainable rural development, and agrarian reform. . . . **Drew Altman**, PhD '83, of the Henry J. Kaiser Family Foundation, has been elected a member of the Institute of Medicine. With their election, members make a commitment to devote a significant amount of volunteer time on committees engaged in a broad range of studies on health policy issues. Current institute projects include the identification of measures to strengthen U.S. dental education, and the issues and implications of tests used to detect genetic disorders.

The Association of Alumni and Alumnae has been notified that **Victor L. Berman**, SM '60, of Beverly Hills, Calif., died on January 16, 1989. No further information was provided.

XVIII MATHEMATICS

Mark V. Matthews, SM '87, Course XVIII assistant professor, has been selected to be the next holder of the Cecil and Ida Green Career Development Professorship. Matthews, an applied mathematician, has been on the faculty at MIT since 1991. He has taught subjects in probability and statistics, statistics for applications, statistical computing, and multivariate analysis. . . . *The Actuary: The Newsletter of the Society of Actuaries* (May 1993), recently ran a small piece about **Robert R. Reitano**, PhD '76. Reitano is a senior investment policy officer and director of research at John Hancock Mutual Life Insurance Co. His paper, "Non-parallel Yield Curve Shifts and Convexity," has been accepted for publication in Volume 44 of *Transactions*. He has been published in *ARCH, The Journal of Portfolio Management*, and the *Transactions* (Vol. 34, 42, and 43). His paper, "Multivariate Duration Analysis" was awarded the SOA Annual Prize in 1992. Reitano has been an assistant professor at the University of Massachusetts, an instructor for the Actuaries Club of Boston, and a visiting scholar at MIT.

The Association of Alumni and Alumnae has been notified that **Kenneth E. Perry**, '49, of Wayland, Mass., died on November 22, 1988. No further information was provided.

XX APPLIED BIOLOGICAL SCIENCES

Vernon Young, professor of nutritional biochemistry in the School of Science, has been elected to the Institute of Medicine. With their election, members make a commitment to devote a significant amount of volunteer time on committees engaged in a broad range of studies on health policy issues. Current institute projects include the identification of measures to strengthen U.S. dental education, and the issues and implications of tests used to detect genetic disorders.

XXI HUMANITIES

Fred R. Shapiro, '74, has recently published *The Oxford Dictionary of American Legal Quotations* (Oxford University Press, 1993). Shapiro is an assistant librarian for public services at the Yale Law School.

XXII NUCLEAR ENGINEERING

Martin Zimmermann, SM '89, writes: "I have finished a PhD at the ETH Zurich in Switzerland, and am now working as a management consultant at McKinsey & Co., Inc., in Germany."

XXIV LINGUISTICS AND PHILOSOPHY

David Pesetsky, PhD '83, Course XXIV associate professor, has been awarded a Graduate Teaching Award by the Graduate Student Council. Graduate students cast votes for their favorite professor and one award is presented to a professor in each of the five schools at MIT.

TPP TECHNOLOGY AND POLICY PROGRAM

The MIT Center for International Studies has announced that **James S. Risbey**, SM '90, was awarded the 1993-94 International Energy and Environmental Policy Grant, provided through the Japan Endowment, for a project on the Use of Climate Models to Assess the Impacts of Regional Climate Change on Water Resources. . . . **Jan Van Acker**, SM '91, completed his military service for Belgium and is now working with Eli Lilly. He is responsible for all financial issues for the Dutch subsidiary of Eli Lilly, and is working both in Brussels and in the Netherlands. A wedding is being planned for August 27, 1993—Congratulations! .

Seabron "Seab" Adamson, SM '92, is currently in Krakow, Poland, where he is working on a SO2 Control Program for the World Bank.

Steve Downs, SM '92, is on staff in the Office of Disease Prevention and Health Promotion within the Public Health Service (which is part of the Department of Health and Human Services) in Washington, D.C. He is working on the establishment of a Center for Advanced Health Communications Technology, which is designed to promote awareness of and encourage experimentation with using new technologies to communicate health information.

Hotasi Nababan, SM '93, has accepted a position in the Corporate Planning Group of Garuda Airlines in Indonesia. . . . **Jim Rymarczuk**, SM '93, has accepted a position with McKinsey & Co. in Washington, D.C. . . . **Todd Tamura**, SM '93, is now working at Tech Environmental, Inc.—**Richard de Neufville**, TPP, MIT, Room E40-252, Cambridge, MA 02139.

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

Donald H. Radford, '12; June 21, 1992; Duluth, Minn.
Herbert W. Hatch, '18, SB '20; May 12, 1993; Auburn, Me.
Max Seltzer, '18; May 15, 1993; Needham, Mass.
John R. Hardin, '21; January 9, 1993; Easton, Md.
Calvin L. Young, '22; January 29, 1993; Abilene, Tex.
Percival J. Higgs, '22; April 26, 1992; Ottawa, Canada
Miguel F. Amezcaga, '24; April 5, 1993; Bethesda, Md.
Harold Clarke, '24; January 11, 1992; Portland, Ore.
James B. MacLean, '24, SM '25; May 9, 1993; Wilbraham, Mass.
John M. Campbell, '25; May 11, 1993; Birmingham, Mich.
Peter L. Bellaschi, '26, SM '28; May 21, 1993; Portland, Ore.
Robert T. Dawes, '26, SB '27; May 13, 1993; Hudson, Mass.
Benjamin Margolin, '26; June 9, 1993; Cambridge, Mass.
Alexander C. Wallace, '26; May 17, 1992; Salt Lake City, Utah
James E. Cushing, '27, SB '28; October 8, 1992; Arlington, Mass.
Philip G. Rhoads, '27; May 5, 1993; Wilmington, Del.

George S. Hubbard, '28; April 1, 1993; San Diego, Calif.
 James C. Coe, '29; May 1, 1993; Phoenix, Ariz.
 James F. Hale, '29; April 10, 1993; Middlefield, Mass.
 Malcolm M. Hubbard, '29; April 24, 1993; Gloucester, Mass.
 Wayne F. Koppes, '29; January 29, 1992; Jamesburg, N.J.
 George L. McKenna, '29, SM '30; April 27, 1993; Vero Beach, Fla.
 Helen Walther, '29; October 4, 1991; Blairstown, N.J.
 Frederick W. Holt, Jr., '30; December 11, 1992; Boca Raton, Fla.
 Victor M. Gelin, '32; November 26, 1992; Winter Haven, Fla.
 William L. Wells, '32, SM '36; November 1, 1992; Wilmington, N.C.
 Robert A. Dobson, '33; May 21, 1993; Lincoln, Neb.
 Gustav U. Liljegen, '33; January 24, 1992; Bellevue, Wash.
 Calvin H. Mohr, '33; May 8, 1993; Columbus, Ohio
 John Stuart Patterson, '33; May 21, 1993; Schenectady, N.Y.
 William L. Sorensen, '33; May 28, 1993; Peoria, Ariz.
 William C. Black, '34; March 10, 1993; Cedar Rapids, La.
 Earl A. French, '34; September 27, 1988; Fort Worth, Tex.
 Albert E. Heins, '34, SM '35, PhD '36; June 24, 1992; Ann Arbor, Mich.
 Thomas A. La Cava, '34; April 30, 1993; Concord, N.H.
 Herbert F.R. Plass, '34, SM '35; June 1, 1986; Minnetonka, Min.
 Burton Williams, '34; October 16, 1992; Chesterton, Ind.
 Stuart A. Challender, '35; December 14, 1992; Lakehurst, N.J.
 Douglas Chalmers, '35, SB '36; December 18, 1990; Newport Beach, Calif.
 Hugh L. McMath, '35, SM '36; November 15, 1992; New York, N.Y.
 Thomas J. Chang, '36; 1993; Venice, Calif.
 Alexander C. Veasey, '36; October 18, 1989; Los Gatos, Calif.
 Robert F. Brown, '37; April 26, 1993; Cottage Grove, Ore.
 John R. Maull, '37; March 18, 1993; Leonia, N.J.
 Chester H. Bean, '38; February 2, 1987; Mount Vernon, Me.
 Arthur H. Christgau, '38, SM '39; April 4, 1993; Pleasantville, N.Y.
 James A. Prichard, '38; June 16, 1987; Silverdale, Wash.
 Harry W. Tileston, Jr., '39; May 9, 1993; East Weymouth, Mass.
 Robert W. Chase, '40; January 22, 1993; Oklahoma City, Okla.
 Edward B. Cooper, '40; April 13, 1993; Newark, Del.
 James I. Thomas-Stahle, '40; April 22, 1993; Richardson, Tex.
 Delano Wight, '40; January 4, 1990; Green Valley, Ariz.
 Mabra G. Abernathy, '42; June 5, 1980; Columbia, S.C.
 Joseph Franklin, '42; May 5, 1993; Brookline, Mass.
 David P. Heffernon, '42; February 27, 1991; Rockford, Ill.
 John E. Guillotte, '43; April 12, 1993; Wilmington, Del.
 Edward M. Jones, '44; January 26, 1993; Cincinnati, Ohio
 Robert L. Meier, '44; June 15, 1993; Brewster, Mass.

Charles C. Buik, III, '45; March 23, 1990; Hinesburg, Vt.
 Robert L. Horowitz, '47; March 19, 1993; Newton, Mass.
 John H. Keefe, '47, SM '48; February 23, 1992; Naples, Fla.
 Rose A. Armstrong, '48; August 19, 1992; Racine, Wash.
 Harry J. Beattie, Jr., '48; March 9, 1987; Fairport, N.Y.
 Benjamin H. Danziger, '48; May 19, 1993; New York, N.Y.
 Charles E. Fogg, '48; May 14, 1993; Sanbornville, N.H.
 Ronald C. Gillis, '48; April 22, 1993; Downey, Calif.
 Robert T. Andrew, '49; May 8, 1993; Manassas, Va.
 Sigurd Hallager, Jr., '49; February 19, 1993; Lincoln, N.H.
 Stephen J. Kovacs, '49; May 26, 1993; Dallas-town, Pa.
 Winfield W. Evans, SM '50; September 24, 1989; Oklahoma City, Okla.
 Eugene R. French, '50; May 12, 1993; Leonia, N.J.
 Alan C. McClure, '50; May 1, 1993; Houston, Tex.
 Gordon G. Robeck, '50; February 21, 1993; Laguna Hills, Calif.
 James S. Rowley, '50; June 6, 1993; West Yarmouth, Mass.
 Allan W. Shaw, '50, SM '51; May 29, 1993; Arlington, Tex.
 David M. Uline, '50; December 18, 1983; Rochester, N.Y.
 Elbert F. Durfee, Jr., '51; May 12, 1993
 Oscar R. Falconi, '51; April 18, 1979; Saratoga, Calif.
 Charles H. Ehlers, '52; June 18, 1993; Concord, Mass.
 Robert E. Kane, '53; April 2, 1993; Honolulu, Hawaii
 Richard G. Locarni, '53; April 2, 1993; Carthage, Mo.
 Laura E. Case, '54; October 17, 1987; Winchester, Mass.
 Harrington T. Price, '55; February 19, 1993; Sun City, Ariz.
 Robert S. Duncan, '58; November 1, 1990
 Jack L. Kesten, '58; March 21, 1991; Chesterfield, Mo.
 Victor L. Berman, '60; January 16, 1989; Beverly Hills, Calif.
 Gerard R. Cugini, '60; April 25, 1993; Bellingham, Mass.
 Kenneth I. Lichti, '61; January 27, 1993; Ventura, Calif.
 Joseph J. Schiffer, '61; May 31, 1993; Dennis, Mass.
 Charles L. Ruttenberg, '61; May 3, 1993; Silver Spring, Md.
 Edward A. Zukowski, '63; May 2, 1993; Hopewell Jct., N.Y.
 John W. Horton, '66; April 20, 1993; Bellville, Tex.
 Kenneth B. Moore, '66; February 2, 1993; Mendocino, Calif.
 Wayne P. Stevens, '66, SM '67; May 22, 1993; Fairfield, Conn.
 Louis Castelli, '67; June 21, 1990; Dallas, Tex.
 George E. Wyatt, '69; November 25, 1987; Buffalo, N.Y.
 Wallace E. Morrow, '71; March 18, 1993; Kent, Ohio
 Frank Tariello, Jr., '71; April 30, 1990; Schenectady, N.Y.
 Phyllis A. Daly, '73; January 11, 1984; Davidson, N.C.
 Kenneth W. Vaca, '74; January 4, 1993; Cicero, Ill.
 Mark R. Koupal, '76; August 18, 1992; Prairie Village, Kan.

Since this is the first issue of a new academic year, I once more review the ground rules under which this department is conducted.

In each issue I present three regular problems (the first of which is chess, bridge, go, or computer-related) and one "speed" problem. Readers are invited to submit solutions to the regular problems, and three issues later, one submitted solution is printed for each problem; I also list other readers who responded. For example, solutions to the problems you see below will appear in the February/March issue and this issue contains solutions to the problems posed in May/June. Since I must submit the February/March column in November, you should send your solutions to me during the next few weeks. Late solutions, as well as comments on published solutions, are acknowledged in subsequent issues in the "Other Respondents" section. Major corrections or additions to published solutions are sometimes printed in the "Better Late Than Never" section as are solutions to previously unsolved problems.

For speed problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solution to this issue's speed problem is given below. Only rarely are comments on speed problems published.

There is also an annual problem, published in the January issue of each year; and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

Finally, I must confess to being somewhat in shock so forgive any errors you find. My colleague and friend, David Gelernter from Yale, the originator of the Linda programming language, has



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

Indulging in a Little Tetrahedronism

just been seriously injured by a letter bomb and is now in the hospital. I am sure I join all his friends in wishing David and his family strength and good fortune in the difficult recovery period to come. I dedicate this column to him.

Problems

OCT 1. Unfortunately, I inadvertently omitted part of the M/J 1 question that Tom Harriman calls "Superweiner." The correct Superweiner is as follows (now renumbered OCT 1).

The opening lead is the three of clubs by West. How does South make the contract of seven spades?

North			
♠	10 9 8 7 6		
♥			
♦	A K		
♣	A 10 9 8 7 6		
West		East	
♠		♠	5 4 3 2
♥	9 8 7 6 5 4	♥	K Q J 10
♦	6 5 4 3 2	♦	
♣	3 2	♣	K Q J 5 4
		South	
		♠	A K Q J
		♥	A 3 2
		♦	Q J 10 9 8 7
		♣	

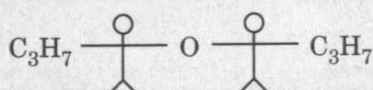
OCT 2. Thomas MacDiarmid asks you to cut a triangle out of paper—an equilateral is best to start with. Then fold each of the corners upward so that the vertices meet; the result is a tetrahedron. This does not work for all triangles. MacDiarmid wants you to determine which triangles can be folded into a tetrahedron with just three folds, one for each vertex.

OCT 3. Nob Yoshigahara wants you to replace each letter by a unique digit (excluding zero).

$$\frac{AB}{CDE} + \frac{FG}{HI} = 7$$

Speed Department

Speedy Jim Landau wonders what is the name of this "chemical."



Solutions

M/J 1. This problem was mis-stated in the May/June issue and the corrected version appears as problem OCT 1 above.

M/J 2. Richard Kluger asks the "surname problem." A hypothetical planet contains n males with n distinct surnames married to n females. In this and all future generations, all females marry, assume their husbands' surnames, and bear 2 children who mature, marry, etc. A child has a 50 percent chance of being female. How many distinct surnames exist after k generations? Couples with identical surnames, including siblings, can marry but transgenerational marriages are not possible.

This probably is a "standard" problem in population theory. It does get complicated to give a full solution, since that would be a probability distribution. Matthew Fountain gives us the following approximation to the mean number of distinct surnames. As noted by several readers, one must decide what to do in a generation there are not the same number of males and females.

When n is large the following table is a reasonable guide to the number of surnames existing in the k -th generation per 1,000 males in the starting generation.

k surnames	k surnames	k surnames
0 1000	10 252	50 66
1 752	15 194	60 58
2 595	20 148	80 43
3 512	25 126	100 38
4 451	30 108	200 24
5 396	40 81	

When n is small it is necessary to consider the fluctuation in population size. The equal probability for a boy or girl at each birth does not mean exactly half the births will be girls. For small n this fluctuation complicates matters to an unwieldy degree. But what populated planet would have a small population?? By restricting myself to large n I could assume with but small error that when there are N males named Smith in one generation there are 2^*N births, each with a probability of $\text{INT}(2^* \text{RND})$ of producing a male named Smith in the next generation.

$\text{INT}(2^* \text{RND})$ is a function that randomly returns either 0 or 1. I compiled the above table by running a computer program based on this assumption that combined the results obtained for 1,000 males, each separately tested for when or if his surname dies out. I re-ran the program several times more and was surprised to see how closely the figures between runs agreed. However, I noted that at $k=100$ the male population size varied widely. In six runs the population size and surnames existing at $k=100$ were 678 and 31, 681 and 32, 814 and 37, 902 and 38, 937 and 35, and 1188 and 39. This scatter of population is to be expected as at $k=100$ the number of males is dependent upon the outcome of approximately 200,000 births.

M/J 3. John Prussing needs help in stalking a drug runner.

A Coast Guard skipper named Pedro is stalking a drug runner named Biff. Both boats are

at rest separated by a distance a . A fog rolls in and Biff flees in a constant but unknown direction at a speed b . Pedro knows the values of a and b and the fact that his boat is twice as fast as Biff's.

a) Determine a simple pursuit strategy which will guarantee that Pedro will intercept Biff in a finite time.

b) Determine the minimum and maximum possible intercept times (the intercept time will vary depending on the direction Biff flees).

The following solution is from Scott Brown. (Pete Davis believes this problem first appeared as a short story in *Collier's* magazine during World War II with the "players" a U.S. destroyer and a Japanese submarine.)

Biff flees on a constant but unknown course, at a known speed b . Pedro must design a track with speed $c=2b$, which is guaranteed to intercept Biff. Pedro also wants to determine the earliest and latest intercept times.

We solve the problem in a polar coordinate system centered on Biff's initial position, with Pedro's initial position at $(r=a, \theta=0)$. The earliest possible intercept occurs if Pedro and Biff head toward each other. Since Pedro and Biff can close the distance, a , between them at a rate of $b+c$, the earliest intercept occurs at time $t=a/(b+c)$. Pedro chooses the path which makes this possible, i.e., $r(t)=a-c \cdot t$ and $\theta(t)=0$ for $0 \leq t \leq a/(b+c)$.

Thereafter, Pedro knows that Biff's position always satisfies $r(t)=b \cdot t$ so Pedro maintains this range and chooses θ to satisfy his speed constraint, $(dr/dt)^2 + r^2(d\theta/dt)^2 = c^2$. Putting $r(t)=b \cdot t$ into this equation gives $d\theta/dt = \sqrt{(c^2 - b^2)/b^2} \cdot t^{-1}$. An easy integration, and the initial condition $\theta(a/(b+c))=0$, give $\theta(t) = \sqrt{(c^2 - b^2)/b^2} \ln(t \cdot (b+c)/a)$. Pedro is guaranteed to have found Biff when $\theta(t)=2\pi$ i.e., $t=(a/(b+c)) \exp(2\pi \sqrt{b^2/(c^2 - b^2)})$. Finally, substituting $c=2b$, Pedro's path is $r(t)=a-2bt$ and $\theta(t)=0$ for $0 \leq t \leq \frac{a}{3b}$ = earliest intercept time; $r(t)=b \cdot t$

and $\theta(t) = \sqrt{3} \ln\left(\frac{3bt}{a}\right)$ for $\frac{a}{3b} \leq t \leq \frac{a}{3b} \exp(2\pi/\sqrt{3})$ = latest intercept time. (Note that this solution shows that Pedro can intercept Biff whenever $c > b$.)

Better Late Than Never

1992 OCT SD1. Speedy Jim Landau reports that this problem was actually told to him by Eric Weill.

1993 F/M 3. Harold Boas notes that our four-bug problem has been mentioned in both the November 1957 and July 1965 installments of Martin Gardner's column in *Scientific American*. The latter issue features a multicolor illustration of the problem on the cover!

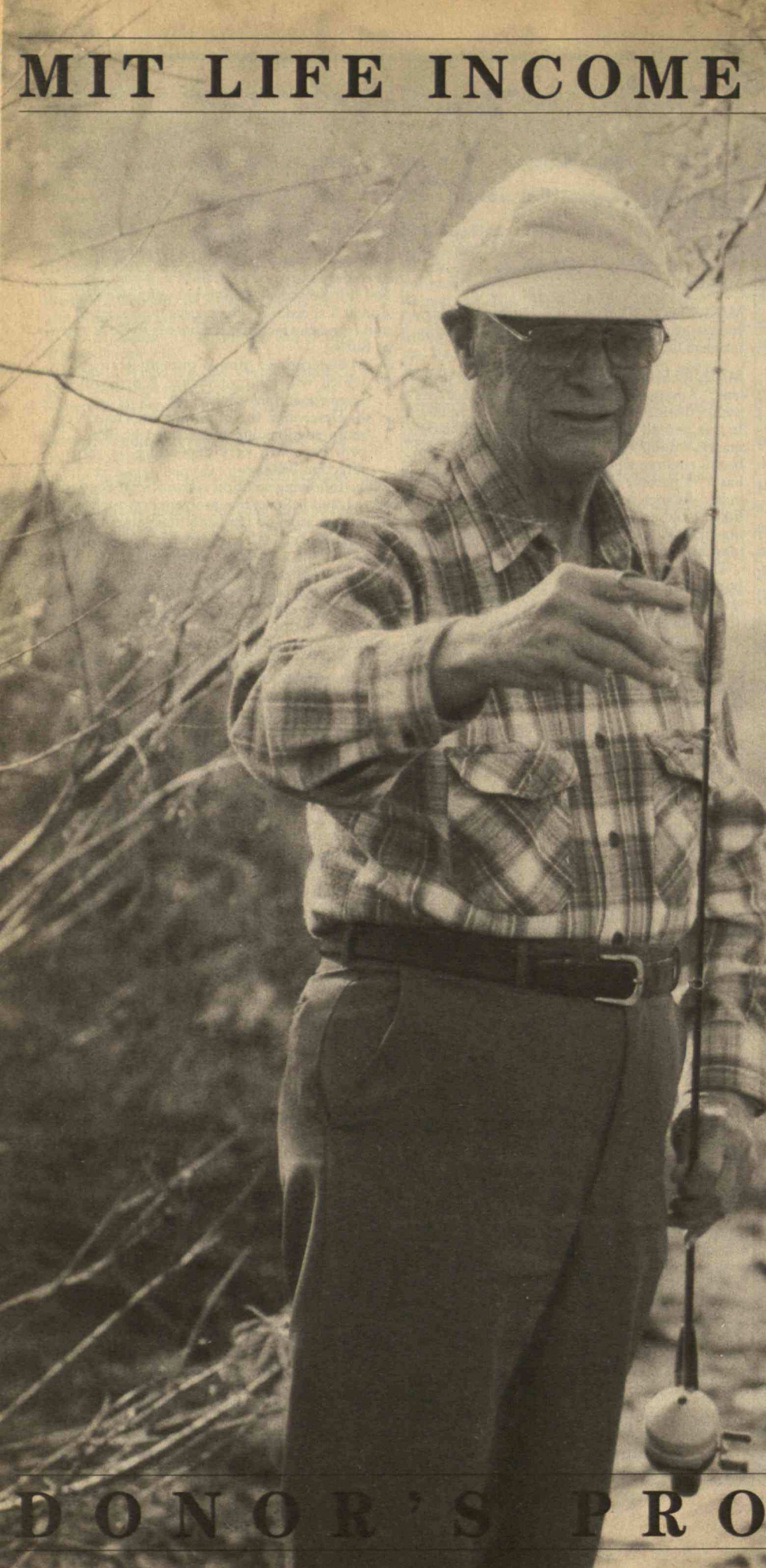
Other Responders

Responses have also been received from G. Blondin, B. Cain, D. Church, R. Davis, M. Gennert, J. Grossman, J. Harmse, R. Hess, J. Landau, S. Portney, K. Rosato, M. Schwier, M. Seidel, S. Shapiro, A. Sherwood, and S. Weiss.

Proposer's Solution to Speed Problem

Diproply people ether.

MIT LIFE INCOME FUNDS



MR. GEORGE P. PALO

HOME: Rochester, Minnesota

CAREER: Growing up in Superior, Wisconsin, Mr. Palo earned an S.B. in civil engineering from MIT in 1928. He held various jobs for the next five years, but the main event was his marriage to Anne Groebler. In 1934, he joined the Tennessee Valley Authority in Knoxville. Except for service in the U.S. Navy in Washington, D.C., 1944-45, Mr. Palo stayed with the TVA until he retired in 1969, serving in a variety of capacities, including head structural engineer, chief engineer from 1959-1963, and, finally, manager of engineering design and construction. In 1990, the Palos moved to Minnesota. Mr. Palo was a member of the Educational Council from 1949 to 1990 and a class agent since 1982. Mr. and Mrs. Palo both became Life Sustaining Fellows in 1983, and throughout the years they visited MIT as often as possible.

LIFE INCOME FUND: George P. Palo Fund in the Maclaurin Pooled Income Fund. After Mrs. Palo died, he established a Ralph Huntington Gift Annuity, naming his sister as the beneficiary.

QUOTE: My wife Anne and I both began contributing to the Maclaurin Pooled Income Fund in 1982. The returns from the fund have compared favorably with the ten percent return from U.S. Treasury notes in the 1980s or with the combined dividend and capital gains typical for good stocks in those years. With current interest rates, returns from the Huntington Funds are even more favorable, enabling me to insure adequate income for my sister.

For more information about gifts of capital, write or call D. Hugh Darden, W. Kevin Larkin or Frank H. McGrory at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Lower Photography
Rochester, Minnesota

DONOR'S PROFILE

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Bogged down in Bangkok.



A NEW Energy Path FOR THE Third World

BY NICHOLAS LENSSEN

IN their efforts to improve the lives of the 4 billion people who live in Africa, Asia, and Latin America, development agencies have clung to a questionable assumption: that a growing energy supply is the necessary foundation for expanding industries, providing jobs, and raising standards of living in the Third World. On the face of it, that assumption seems logical enough, since high energy use is a conspicuous trait of the most developed nations. In practice, the notion of

The old path, based on ever-higher consumption of fossil fuels, is leading developing countries to environmental and economic ruin.

A better route combines more efficient technologies with alternative sources.

PHOTO: ROCKY WELDON/ FPG INTERNATIONAL

equating energy consumption with economic health has begun to unravel.

Developing countries have more than quadrupled their energy use since 1960, doubling their per capita use. Yet the strategies that have been so successful in achieving this growth have left these nations staggering from oil price shocks, struggling with foreign debt, and suffering from serious environmental and health problems—while still facing severe energy shortages.

Despite more rapid energy development in the South than in the North, the income gap between the hemispheres has been growing, not shrinking. In 1960, the richest fifth of the world's countries produced 30 times more income per person than the poorest fifth, according to the United Nations Development Programme. By 1989, the disparity had widened to 60 to 1. Over the past decade, per capita incomes have declined in some 50 countries. In Latin America, where some of the world's largest energy projects have been built, three-quarters of the population saw its income fall in the 1980s.

This occurred partly because developing economies were saddled with back-breaking debts to foreign banks and governments—debts totaling \$1.43 trillion in early 1993. And as debt deepened poverty by siphoning off state funds, rising energy use deepened the debt. In Brazil and Costa Rica, for example, one of every four borrowed dollars went to pay for giant electric power projects.

At the same time, environmental and health costs associated with energy use and production are taking a mounting toll. In coal-dependent China, acid rain falls on at least 14 percent of the country, damaging forests, crops, and water ecosystems, and cities have 14 times the level of suspended particles found in the United States.

Elsewhere, urban air is choked with pollution from motor vehicles. Mexico City, where ozone levels violated international standards 303 days in 1990, is joined by Bangkok, Nairobi, Santiago, and São Paulo in the growing list of cities whose people suffer lung damage despite per capita levels of energy consumption far below those of Northern cities.

Conventional energy development has also increased the threat of global warming. Although industrial countries are responsible for 79 percent of the fossil fuel-derived carbon dioxide emitted since 1950, and still accounted for 69 percent of the total in 1990, future growth in fossil-fuel use is predicted to be greater in the South than in the North. If recent trends continue, emissions in the developing world will grow from 1.8 bil-

lion tons of carbon in 1990 to 5.5 billion tons in 2025, according to the U.N.'s Intergovernmental Panel on Climate Change (IPPC). China alone is expected to emit more carbon dioxide by 2025 than the current combined total of the United States, Japan, and Canada. Such increases would boost global emissions by half at a time when, according to the IPPC, they should be cut by at least 60 percent if the atmospheric concentration is to be stabilized and climate change minimized.

For all the ills brought on by expanded energy use, many developing countries are still contending with shortages of electricity. India's shortfall averages 9 percent, rises to 22 percent during peak periods, and is worsening. China's shortfall results in regular shutdowns of industry; it idled one-fourth of the country's industrial capacity in 1987. According to World Bank estimates, electricity shortages are costing Latin America's industry as much as \$15 billion per year in lost output. And then there are the 2.1 billion people worldwide who live in areas with no electricity at all.

With such a gulf between supply and demand, funding agencies and Third World government planners can be expected to continue their efforts to expand energy supplies for years to come. After all, people in the developing world still use just one-ninth as much commercial energy on average as those in industrial countries (*see the table on page 46*). Yet if developing countries are to achieve the hoped-for gains in living standards, they need to meet their energy demand in a way that allows them to close the economic gap between North and South and maintain the health of their people, forests, cropland, and waterways.

Developing countries can achieve sustainable energy development by following a two-part strategy. First, they will need to emphasize the use of more energy-efficient technologies in everything from industrial processes to consumer products. Over the next 35 years, \$350 billion invested in efficiency improvements could eliminate the need for \$1.75 trillion worth of power plants, oil refineries, and other energy infrastructure by reducing growth in energy demand, according to a study at the Lawrence Berkeley Laboratory (LBL). This would free up money for vastly larger investments in food production, health, education, and other neglected needs. Second, the Third World will need to develop its own alternatives to costly oil and polluting coal. Many developing countries have extensive untapped reserves of natural gas, which could supplant oil and coal in buildings, transport, industry, and power generation. And all have enormous potential to rely on solar, wind, biomass, or geothermal energy. Through a combination of efficiency and alternative energy sources, developing countries can "leapfrog" to the advanced technologies being commercialized in industrial countries today, avoiding billions of dollars of misdirected investments in infrastructure that is economically and environmentally obsolete.

NICHOLAS LENSSEN, a senior researcher at Worldwatch Institute in Washington, D.C., is coauthor of *The Coming Energy Revolution*, W.W. Norton (1994). From 1984 to 1987, he worked on rural development in Ecuador with the Peace Corps. This article is adapted from his *Worldwatch* paper "Empowering Development: The New Energy Equation."

Using Energy Wisely

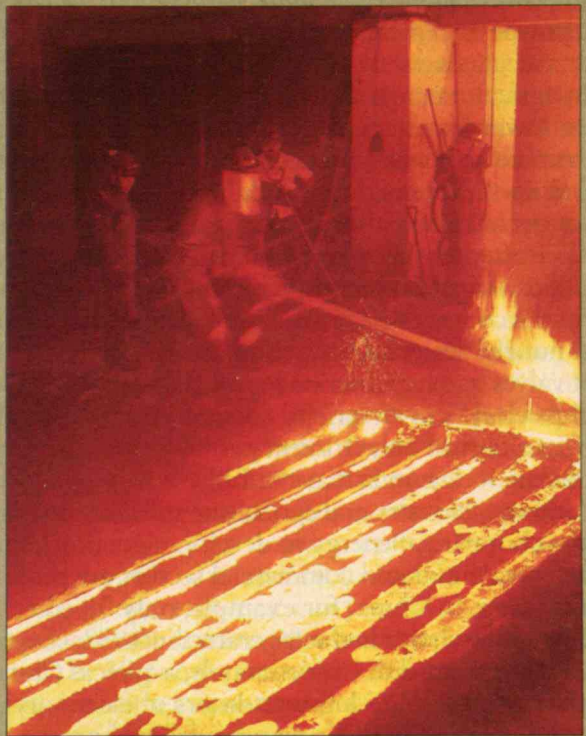
Since the 1973 Arab oil embargo, industrial countries have made large gains in using energy economically. Energy use by the 24 member nations of the Organization for Economic Cooperation and Development (OECD) rose only one-fifth as much as economic growth between 1973 and 1989. However, these gains have largely bypassed developing countries, where energy use expanded 20 percent faster than economic growth during the same period.

Developing-country economies now require 40 percent more energy than industrial ones to produce the same value of goods and services. This is mainly because they are using outdated technologies that squander energy. The gross inefficiency of these technologies—whether wood stoves, cement plants, light bulbs, or trucks—offer innumerable opportunities to limit energy consumption and expenditures while expanding the services they provide. For example, the congressional Office of Technology Assessment estimates that nearly half of overall electricity use in the South can be cut cost-effectively.

Half of Third World commercial energy consumption goes to industry, yet for each ton of steel or cement produced, the typical factory in the global South uses far more energy than its Northern counterpart. Steel plants in developing countries consume roughly one-quarter more energy than the average plant in the United States, and about three-quarters more than the most efficient plant. Fertilizer plants in India use about twice as much oil to produce a ton of ammonia as a typical British plant. Pulp and paper facilities consume as much as three times more energy for the same amount of output. Such records are often the result of poor maintenance and operating procedures and can be readily improved—given sufficient information and incentive to do so. A study by Indonesian researchers, for example, found that that country's industries could cut energy use 11 percent without *any* capital investment, simply by changing operating procedures. Similarly, a Ghanaian survey found potential savings of at least 30 percent in medium- to large-scale industries.

Some of the biggest opportunities to save energy and money can be found in the electric power industry. Third World power plants typically burn one-fifth to two-fifths more fuel for each kilowatt-hour generated than those in the North, and they experience far more unplanned shutdowns for repairs, as they are often operated by undertrained staff and poorly maintained, according to the World Bank.

Because the developing world is still in the early stages of building its industrial infrastructure, it has opportunities to base future development not just on more efficient processes but also on more efficient products. Building a \$7.5 million factory for making compact fluorescent light bulbs, for example, would elimi-



Top: Heavy industry in developing countries is ripe for an efficiency drive. Relying on outmoded equipment and processes, Third World steel plants use three-fourths more energy than the best plants in the United States.

Bottom: Large-scale hydroelectric projects, often promoted by development agencies, flood vast tracts of land and displace tens of thousands of people. They also swell foreign debt: the Itaipu Dam is expected to cost Brazil and Paraguay \$21 billion, excluding interest.

nate the need to construct \$5.6 billion worth of coal-fired power plants, if the bulbs (which need 75 percent less power than incandescent ones) were used domestically, calculates Ashok Gadgil of LBL.

In agriculture, too, there is an urgent need for movement toward greater energy efficiency: farming is likely to become more energy-intensive as population growth drives up the demand for food. Besides requiring large amounts of chemicals, agriculture in developing countries is often a major consumer of electricity. India's 8 million irrigation pumps, which use nearly one-quarter of the country's electricity, employ inefficient motors and poorly designed belts, and are plagued by leaky foot valves and high friction losses. Using more efficient pumps could cut electricity consumption by roughly half, at a cost of only 0.1 cent per kilowatt-hour saved, according to Jayant Sathaye of LBL.

Although industry and agriculture still consume most of the commercial energy in developing countries, the urban residential and commercial sectors are growing much faster. In China, for example, only 3 percent of Beijing's households had refrigerators in 1982; six years later, 81 percent did. Unfortunately, a typical Chinese refrigerator uses 365 kilowatt-hours of electricity per year, whereas a South Korean model of the same size uses 240 kilowatt-hours and a Danish one needs less than 100 kilowatt-hours. Industrial planners and manufacturers in developing countries are rarely concerned with the energy efficiency of their products—only with producing and selling more of them by keeping the initial cost as low as possible.

The same can be said of architects and civil engineers. Much of the developing world relies on air conditioning in commercial buildings. Improved building designs—including insulation, better windows, and natural ventilation—could cut cooling needs and costs, but such designs are not widely used. In Bangkok, for example, large offices typically use windows made of a single sheet of glass. By substituting advanced double-paned windows with a special low-emissivity coating (which filters out infrared rays but passes visible light), builders would reduce not only the subsequent electricity costs but the initial costs of construction, since they would then be able to install smaller, less expensive air conditioners.

Efficiency improvements can even be made in the use of biomass—wood, charcoal, or agricultural residues—for cooking, allowing women to spend less time or money acquiring fuel. Although energy-efficient stoves promoted by development agencies in the 1970s were costly and unreliable, an improved charcoal stove—the ceramic jiko—has become a major success in Kenya and other African countries. In India, a government program had distributed some 6 million advanced cookstoves by early 1989.

A third venue of rapidly growing energy consumption is transportation. In China, transportation doubled its percentage of national oil consumption between 1980 and 1988. In most developing countries, this sector accounts for over one-half of total oil consumption, and one-third of commercial energy use. Congestion in Bangkok has dropped the average vehicle speed from 7

COMMERCIAL ENERGY CONSUMPTION

REGION	1970		1990	
	ENERGY CONSUMPTION ¹	PER CAPITA ²	ENERGY CONSUMPTION	PER CAPITA
DEVELOPING COUNTRIES	30	12	84	21
—LATIN AMERICAN	8	26	16	37
—ASIAN	19	10	59	20
—AFRICAN	4	10	9	14
INDUSTRIAL COUNTRIES	129	180	154	185
CENTRALLY PLANNED ECONOMIES	44	120	71	167
WORLD	203	55	310	59

¹ EXAJOULES

² GIGAJOULES

Higher energy use has failed to bring prosperity to developing countries. Even though their consumption rate has grown far faster than that of the industrialized world, the income gap between rich and poor nations continues to widen.

miles per hour in 1980 to about 3 today. Although major improvements are needed in traffic management, mass transportation, and land-use planning, just promoting wider use of bicycles and other nonmotorized vehicles would stem automotive ills while increasing the mobility of the poor.

In combination, the efficiency potential now within reach for industry, agriculture, construction, and transportation could provide an enormous boost to the economies of developing countries. By investing \$10 billion a year, these countries could cut future growth of their energy demand in half, lighten the burden of pollution on their environments and health, and stanch the flow of export earnings into fuel purchases. Gross savings would average \$53 billion a year for 35 years, according to the LBL study.

Although such large-scale savings remain paper prophecies, some countries have achieved notable successes. In 1980, China launched an ambitious program to improve energy efficiency in major industries. By directing roughly 10 percent of its energy investment to efficiency over five years, the nation cut its annual growth in energy use from 7 percent to 4 percent, without slowing growth in industrial production. Efficiency improvements accounted for more than 70 percent of the energy savings, with shifts toward less energy-intensive industries yielding the remainder. And efficiency gains were found to be one-third less expensive than comparable investments in coal supplies. One result was that China's energy consumption expanded at less than half the rate of economic growth from 1980 through 1988.

Brazil's National Electricity Conservation Program has catalyzed impressive savings of energy and money. Over four years, it spent \$20 million on more than 150 efficiency projects and programs, for which local governments and private industry provided matching funds. Most of the money went to education and promotion programs to increase awareness of the savings efficiency could generate. The program also encouraged the National Development Bank to offer low-interest loans to businesses willing to invest in efficiency. These efforts yielded electricity savings worth between \$600 million and \$1.3 billion in reduced need for power plants and transmission lines, estimates Howard Geller, executive director of the American Council for an Energy-Efficient Economy, who has intensively studied the Brazilian energy sector.

Brazil and China need not be anomalies: similar potential exists throughout the developing world. Halving the rate at which Third World energy demand grows over the next 30 years would hold the overall increase to a doubling of consumption rather than a tripling. That difference could have profound consequences for environmental and human health worldwide—and for the ability of the developing world to meet the basic needs of its growing population.

Developing Alternatives

If Third World countries squeeze all the waste they can out of the way they use energy, they will greatly reduce the need for larger supplies. But in the long run, it will still be necessary to develop new energy sources. Unfortunately, government planners and international institutions still assume that developing countries have to follow the energy path the North blazed a century ago—a strategy that relies primarily on expanding supplies of coal and oil. These two fossil fuels already provide 51 percent of all energy used in developing countries (*see the table below*), and more than 75 percent of commercial energy.

While a few developing nations have improved their export-import balance sheets through oil sales, most face a continual drain on their economies as a result of their dependency on oil. Scarce foreign exchange earned through exports of agricultural products or minerals is spent to import oil for domestic consumption, draining resources away from development. Three-fourths of developing countries are oil importers. And of the 38 poorest countries, 29 import more than 70 percent of their commercial energy—nearly all of it in the form of oil.

Although energy planners have promoted alternatives to fossil fuels, these pose problems of their own. Hydroelectric power provides a third of developing countries' electricity, and less than 10 percent of its technical potential has been tapped. Yet efforts to exploit the rest have run into roadblocks, and orders for large dams have declined in recent years as the real costs—both in capital and in displacement of people—of building them have become more apparent. Nuclear power, too, has fallen short of its promise to supply cheap electricity in developing countries, just as it has elsewhere. The Third World accounts for only 6 percent of the world's nuclear generating capacity, with many programs—including

ENERGY SUPPLIES IN DEVELOPING COUNTRIES, 1991

SOURCE	SHARE
BIOMASS	35
OIL	26
COAL	25
NATURAL GAS	8
RENEWABLES	6
NUCLEAR	<1

Oil and coal provide over half the energy used in the developing world, but underutilized sources like natural gas and renewables could relieve shortfalls without imposing the economic and environmental burdens of fossil fuels.

those of Argentina, Brazil, and India—over budget, behind schedule, and plagued by technical problems. Because of its high cost and complex technology, nuclear power is not a viable option for the vast majority of developing countries.

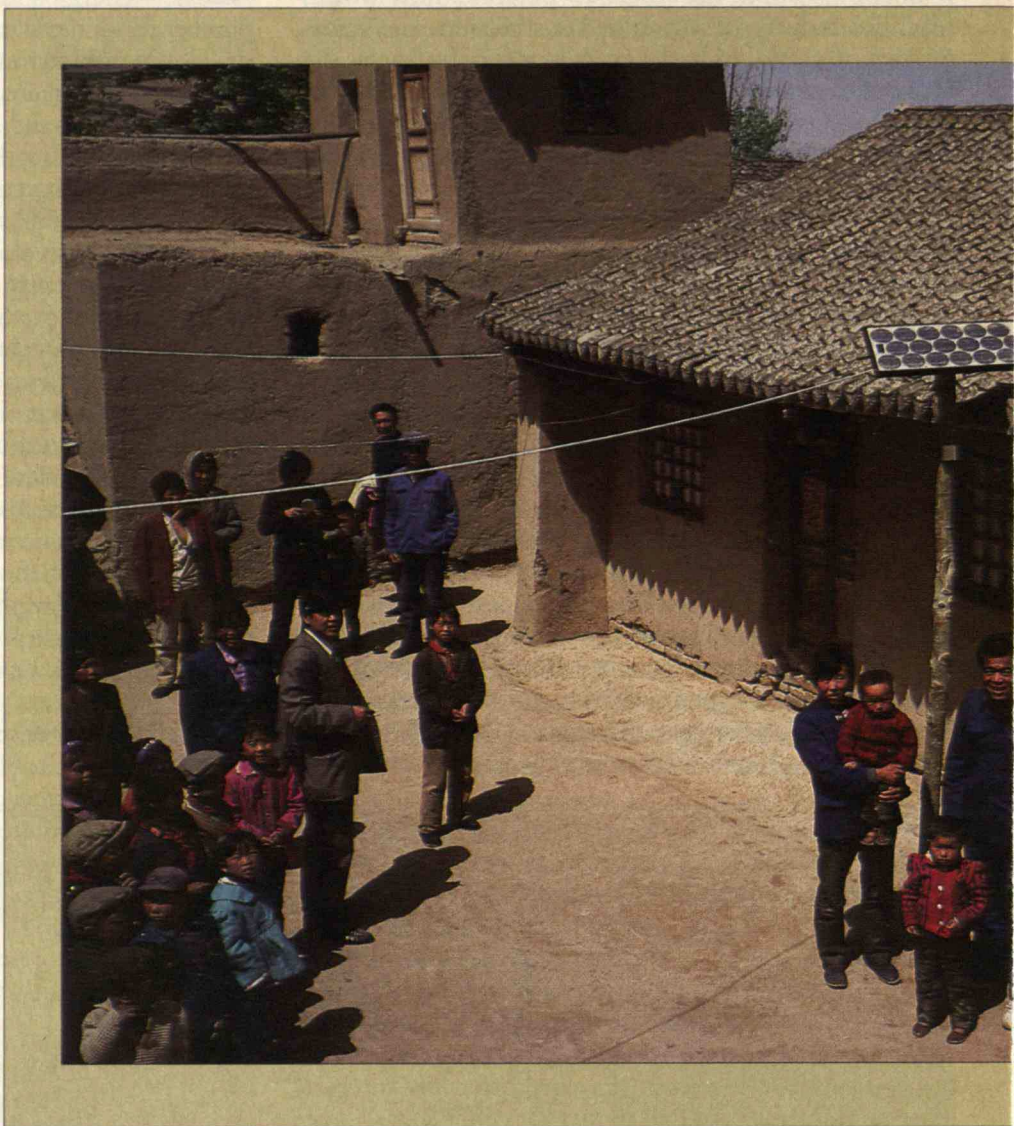
But other, more manageable energy sources are available and waiting to be put to wider use. Natural gas is an obvious example. When oil companies operating in developing countries find natural gas in an exploratory well, they usually cap the well and write the venture off as a tax loss. Such gas reservoirs are simply too small to develop for export markets. Yet locally, the gas in these so-called noncommercial wells could be used for cooking and producing electricity, and could replace coal and oil in factories and motor vehicles. A natural gas well just one-hundredth the size needed for commercial export would be cost-effective for local use, according to Ben W. Ebenhack, a petroleum engineer at the University of Rochester who heads a project to tap previously drilled wells in Africa for local use. The key is building the infrastructure needed to bring natural gas to the large markets awaiting it.

Petroleum geologists have already found substantial reserves of natural gas in some 50 developing countries, and many other countries hold great promise. Most of these stocks are in oil-producing countries such as Algeria, Indonesia, Mexico, Nigeria, and Venezuela, many of which have burned off gas as a waste byproduct of petroleum production without capturing any useful energy.

Nevertheless, the revival of natural gas that has taken place in North America and Europe in recent years has also occurred to some extent in the South. Government and private engineers have drawn up plans for vast networks of gas pipelines that would connect developing countries. In Latin America, Argentina could soon be piping gas over the Andes to smog-choked Santiago, Chile. Another network, which received its initial go-ahead in 1992, will feed Bolivian gas to southern Brazil and northern Argentina. And in southeast Asia, Thailand hopes to build a gas grid with neighboring

Malaysia and Myanmar (formerly Burma).

Even China is reconsidering natural gas as part of its effort to slow growth in oil and coal use. The government formed a gas research institute in 1986 and decided in early 1992 to build a pipeline from a large offshore gas field discovered earlier during an unsuc-



cessful search for oil. Gas commonly accompanies coal as well as oil. It is therefore likely that China, with its enormous coal reserves, is well endowed with natural gas, too.

Developing countries also have abundant supplies of renewable energy resources, such as sunlight, wind, biomass, and heat from deep within the earth, which are becoming more economical. The past decade has seen dramatic technological improvement in tapping these renewables—the costs of solar and wind energy systems, for example, have been slashed by 66 to 90 percent. Electricity sources such as solar thermal power and photovoltaics could be the least expensive route for developing countries, predicts World Bank economist

Dennis Anderson. The availability of land is not a problem: for solar energy to double the Third World's energy consumption, only 0.2 percent of the acreage in these countries would be needed.

Many renewables are already less expensive than fossil fuels or nuclear power, once social and environmen-

by the Office of Technology Assessment. Solar heating industries have already sprung up in many developing countries. Residents of Botswana's capital, Gaborone, have purchased more than 3,000 solar water heaters, displacing nearly 15 percent of residential electricity demand. Some 30,000 of these heaters have been installed in Colombia, and 17,000 in Kenya. In Jordan, 12 percent of the urban water heating systems are solar.

Villagers in some rural areas use photovoltaic cells to power lights, radios, and even televisions, needs that are usually met with kerosene lamps and disposable or rechargeable batteries. With the help of nongovernmental organizations and private businesses, more than 100,000 photovoltaic lighting units have been installed in developing countries such as Colombia, the Dominican Republic, Mexico, and Sri Lanka. In Africa, photovoltaic lighting has undergone a virtual boom since the mid-1980s: Kenya has 10 private companies selling photovoltaics, with as much as 1,000 kilowatts installed.

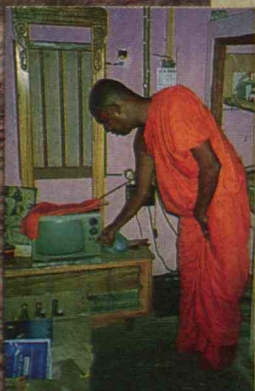
For grid-connected power supplies, geothermal power plants and new wind generators based on variable-speed turbines and advanced blades can produce electricity at a cost comparable to that from coal-fired power plants. India leads the developing world in wind energy, with 38 megawatts of capacity installed by the beginning of 1992. Aided by Danish companies, the country plans to install 1,000 megawatts of domestically manufactured wind turbines by the end of the decade. According to Worldwatch Institute estimates, wind could provide more than 10 percent of developing countries' electricity.

Geothermal energy already plays a major role in some countries; in 1990 it produced 21 percent of the electricity in the Philippines, 18 percent in El Salvador, and 11 percent in Kenya. Yet this resource is abundant—and still largely untapped—in Bolivia, Costa Rica, Ethiopia, India, and Thailand. Another two dozen countries, including Brazil and Pakistan, appear to have equally good, though less explored, potential.

Another advanced technology suitable for developing countries is fuel cells. With even higher efficiency and lower pollution than combined-cycle gas turbines, these battery-like devices convert natural gas, biomass, or hydrogen to electric power and heat. Industrial countries, including Japan and the United States, are commercializing fuel-cell technologies that could be useful in developing countries, especially since fuel cells are modular and require less maintenance than standard electric power plants. India has funded a fuel-cell demonstration project, though investment throughout the developing world has so far been low.

Biomass supplies 35 percent of developing countries' energy but could contribute more if existing agricultural and industrial wastes were better utilized and if more energy crops were produced. Efficient electric power can be generated by gas turbines fired with agri-

Chinese villagers admire their neighbors' new photovoltaic electrical system, one of 100,000 installed with outside aid in developing countries. In Sri Lanka, solar power illuminates a village shop and runs a Buddhist priest's television.



tal costs—such as air pollution, resource depletion, and government subsidies—are included. But even if social and environmental costs are not included, it still makes sense for energy planners to take immediate advantage of renewable energy's potential. Investments in uses that are viable today can stimulate development of the technological and business infrastructure and the domestic expertise, both private and public, needed to apply renewables on a large scale in the future.

Using the sun to heat water is already a cost-effective way to save electricity. Total capital costs for solar hot water are, on average, nearly 25 percent lower than those for electric hot water when the cost of building power plants is included, according to data collected

cultural residues or with forestry wastes that would otherwise be burned at paper and pulp factories. If sugar mills burned all their residues in advanced gas turbines, they would produce more than a third as much electricity as is now consumed in developing countries, according to Robert H. Williams and Eric D. Larson of Princeton University.

Hundreds of millions of acres of degraded lands could be returned to productivity by planting fast-growing trees and other crops suitable for energy use, according to the United Nations Solar Energy Group for Environment and Development. Any such attempt to boost biofuels production, however, would require major investments by governments and private companies. Past efforts to entice villagers to plant more trees have failed more often than not, particularly if the undertaking is packaged as an energy project instead of as a timber- or food-producing venture.

One key may be to integrate biomass energy production with a comprehensive agricultural development strategy that produces marketable items.

Agroforestry techniques, for example, offer a way to boost both food yields and wood harvests. Research in Kenya and Nigeria has shown that mixing corn and leucaena trees can produce 39 to 83 percent more corn than does growing corn by itself, while yielding at least 2 tons of wood per acre. Of course, this approach can do little to help the poorest of the poor, who are landless; indeed, it is difficult to disentangle rural energy problems, and their solutions, from the problems of land ownership and economic equity. But agroforestry could be a boon to landed farmers.

Together with efficiency improvements on the demand side, an energy system run on renewable energy resources and natural gas has the potential to meet all the new energy needs of developing countries, according to Amulya Reddy and his colleagues at the Indian Institute of Science in Bangalore. Reddy's group crafted a plan that could meet the state of Karnataka's electricity needs in the 1990s for only \$6 billion of investment, rather than the \$17.4 billion a government committee had proposed to spend on large hydro-

electric, coal-fired, and nuclear power plants.

Among the new supplies in Reddy's plan are natural gas, solar hot water, and more efficient use of sugar mill wastes and other biomass. Unlike the state's plan, which foresees continuing power shortages despite the enormous investment, Reddy's proposal would electrify all homes in the state and employ more people. At the same time, it would boost carbon-dioxide emissions by only one-fiftieth the amount the government plan envisions.

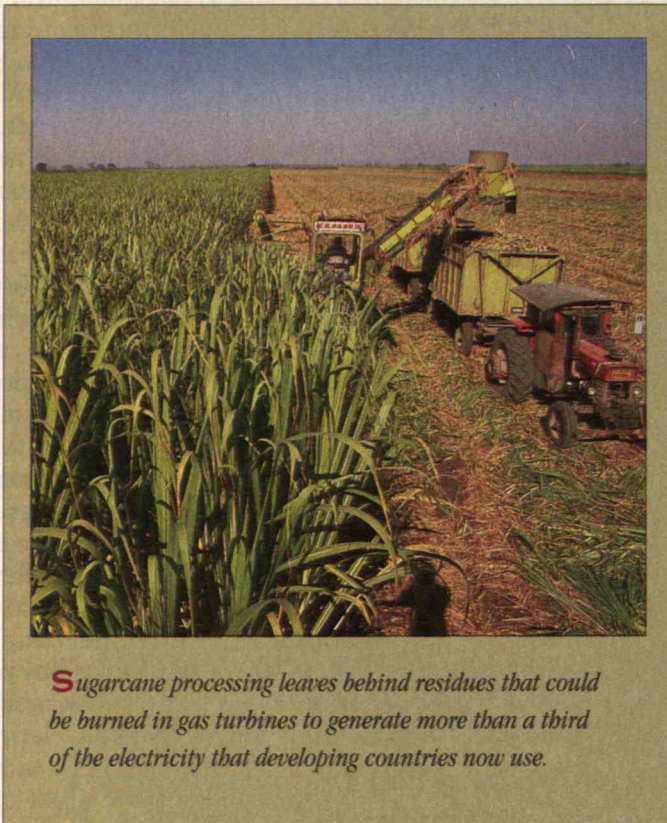
Sustainable Strategies

Even if piecemeal attempts to improve efficiency and exploit alternative sources are successful, comprehensive changes will be needed to ensure that a country's energy development is sound. The kinds of policies that can help make this happen include expunging destructive subsidies from energy prices, so that users will have incentives to conserve; shifting emphasis in energy planning from building new power plants and supplies to providing more efficient energy services; and shifting supply-end

investment from coal and oil to more benign sources.

Implementing these policies will require major institutional changes, from international development agencies, governments, electric utilities, individual industries, and nongovernmental organizations advocating sustainable development. And it is critical that support from the North include not only the billions of dollars annually provided in foreign assistance but also the power of example. That has already occurred to some degree in the development of more energy-efficient industrial processes and consumer products, but the example will become far more persuasive when it includes more substantial shifts to renewable, nonpolluting energy sources and less energy-intensive lifestyles.

Abundant opportunities for promoting end-use efficiency can be found in industrial equipment, home appliances, buildings, and transportation. Some measures are relatively simple: adopting product efficiency standards, putting efficiency labels on products, and publicizing the benefits of efficient products to consumers.



Sugarcane processing leaves behind residues that could be burned in gas turbines to generate more than a third of the electricity that developing countries now use.

Other measures are more complex but no less effective. Utilities, for example, can adopt a policy known as integrated resource planning. Originally pioneered by U.S. utilities and regulators, and now spreading to Canada, Japan, and Western Europe, this policy requires power companies considering new generating capacity to compare the cost of expansion with the cost of improvements in customer energy efficiency. If efficiency measures prove less expensive, utilities invest money in those, instead of in new generating capacity. They also have the option of investing in alternative technologies, such as solar water heaters, that cost-effectively reduce power consumption. Integrated resource planning was recently adopted in Thailand, where utilities expect as a result to save at least \$180 million by 1997.

To encourage such policies, lending agencies need to shift their priorities. The World Bank has started to show more interest in energy efficiency and new energy sources—it recently formed an alternative energy unit in its Asian section, for example, and in 1991 gave India a \$450 million loan to expand its use of natural gas. But like most other multilateral development banks, it still tends to equate energy with expanding centralized electric power. When lending agencies do attempt to promote efficiency, they usually rely on politically difficult price hikes. Instead, the banks could encourage the use of integrated resource planning—as the Asian Development Bank, which operates much like the World Bank, has recently started to do—while investing directly in energy efficiency.

A step in the right direction is the Global Environment Facility (GEF), an international fund set up in 1990 and administered by the World Bank, the United Nations Development Programme, and the United Nations Environment Programme. The GEF finances efficiency and renewables projects by making grants designed to slow global warming. It has supported some promising initiatives, including a \$7 million project for household photovoltaics in Zimbabwe and a \$3.3 million project for energy from sugarcane residues in Mauritius. And it is considering several other worthy ideas: installing efficient lighting in Mexico, capturing methane from coal mines in China, financing improvements in electricity end-use in Thailand, developing biomass-fueled gas turbines in Brazil, and promoting a variety of renewables in India.

But GEF has two limitations. First, its total funds—\$1.3 billion for three years, of which only 40 to 50 percent can be energy-related—are not enough to reform energy development worldwide. The multilateral development banks lend 30 times as much per year on traditional energy projects. Second, the inclusion of efficiency and renewables projects in its portfolio sustains the false notion that they are not economical on their own, but simply a means to reduce carbon-dioxide emissions. The institution's real impact will be felt once the devel-

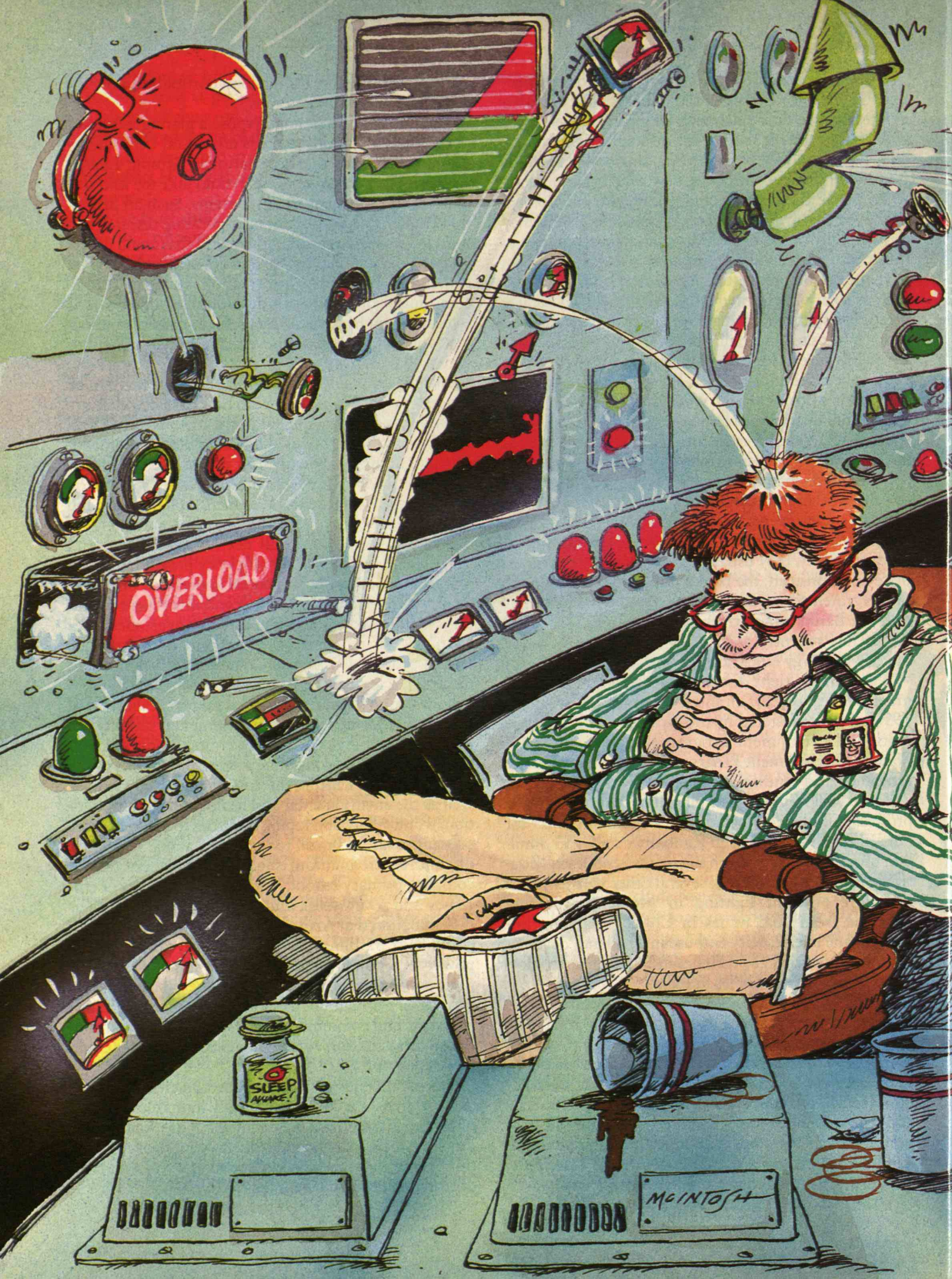
opment banks' entire energy loan portfolios follow the pattern of today's GEF grants.

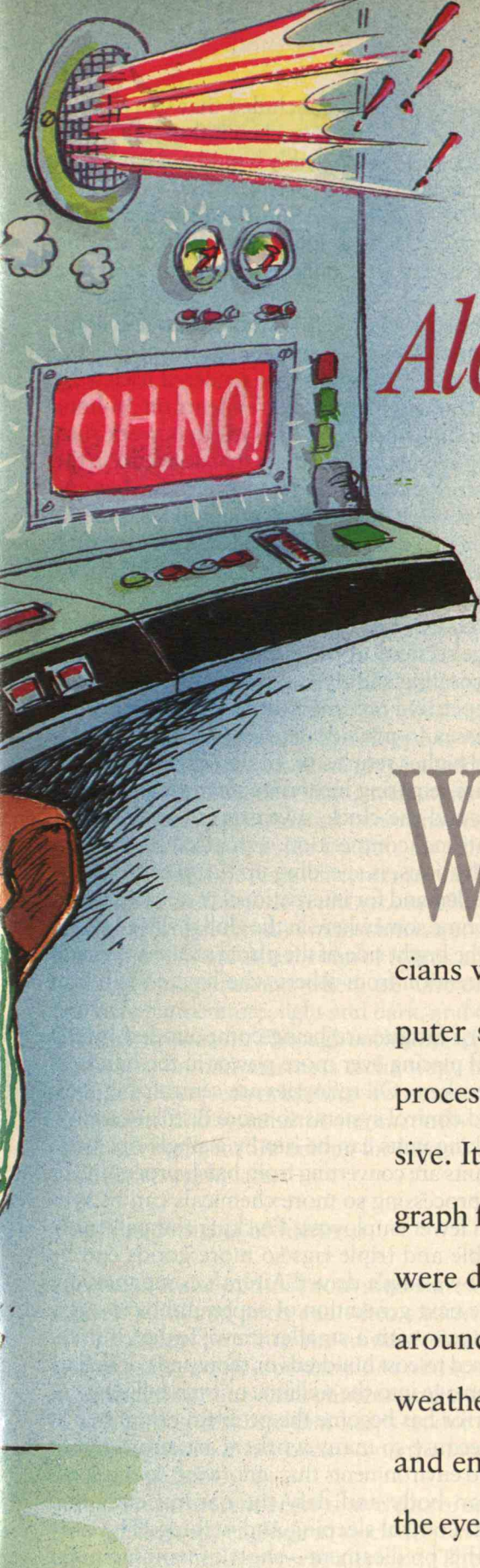
The GEF's shortcomings expose a glaring weakness of the United Nations: there is no central U.N. energy office other than the International Atomic Energy Agency. A new, broader agency could take the lead role in promoting efficient energy systems. Such an institution could be decentralized, incorporating research stations in key regions around the world that could design and demonstrate renewable and efficient technologies, gather and disseminate information, and train technicians and professionals in developing countries. The centers would be particularly useful to smaller developing countries that do not have the resources of nations such as Brazil or India.

At the national level, government programs can be funded by energy taxes or carbon taxes, which are based on the carbon content of the fuel. In early 1992, the Thai parliament levied a tax on petroleum products and natural gas, equivalent to just over 1 cent per liter of petroleum product, that will provide \$50 million to \$60 million a year for investments in efficiency and renewables. Ghana already funds its independent energy board with a small tax on fossil fuels, and Tunisia originally funded its efficiency program through a modest tax on oil. More general application of carbon taxes would encourage research and investment in efficiency and renewables. The Italian government, for example, has recommended that part of the revenue from a proposed European Community carbon tax go to sustainable energy investments in the South.

Such proposals underscore the gradual realization in the North that energy and environmental stability are closely linked. But developing countries need a new energy path for reasons quite apart from threats to the earth's climate. Cutting the cost of energy services, as well as the environmental and health costs of air pollution, would allow developing countries to invest in more pressing areas. In Brazil, for example, about 30 percent of children are malnourished and 78 percent do not complete primary school. With the technologies of efficiency and renewables, and with the policies for their dissemination that have already proved effective, Brazil could shift \$2 billion to \$3 billion a year out of the power sector and roughly double its funding for nutrition, preventive health care, and water and sanitation programs. Throughout the South, investments in transportation and communication systems, health and education infrastructure, water supplies, and shelter could be stepped up.

Indeed, an energy strategy based on clean and efficient sources is a cornerstone of sustainable development and is essential if the countries of the South are to improve their living standards. As countries move to this new strategy, their energy economies will shift from obstructing development to enabling it. ■






BY MARTIN MOORE-EDE

Alert at the Switch

WORK ENVIRONMENTS IN
ROUND-THE-CLOCK INDUSTRIES ARE PUTTING
PEOPLE TO SLEEP. THE EMERGING FIELD
OF HUMAN-ALERTNESS TECHNOLOGY
CAN WAKE THEM UP.



WHILE visiting a major chemical plant, some colleagues and I were taken to admire its ultra-modern control room. Highly trained technicians watched intricate color graphic displays on computer screens as the plant ran through its continuous processes. This was high technology at its most impressive. It would, and did, make a wonderful color photograph for the company's annual report.  Because we were doing some training with the night crew, we hung around and chatted with them—about baseball, the weather, their jobs. As night came on and the managers and engineers left, the lights were switched off “to rest the eyes,” and we sat there in comfortable chairs, the room

ILLUSTRATIONS: JON MCINTOSH

lit only by the dim glow of the monitors. The room temperature was also adjusted up a notch as the crew settled down for the night. It was peaceful and quiet (save for the soporific hum of the computers) as the plant smoothly split and purified molecules, filtering and storing them away.

The setting was so cozy that we wondered how the crew managed to stay vigilant through a 12-hour night shift. It didn't: the things the body naturally craves for comfort in the middle of the night are things that reduce alertness and bring on sleep. "I just set this baby up, pull my cap down over my eyes, and take in some z's," said an operator. "It wakes me if it needs me."

Did the plant bosses realize they were leaving explosive chemicals and multimillion-dollar equipment in the care of foggy-headed operators? The next day we asked the management team and the systems engineers to define the job requirements of a control-room operator. Their definition was straight from the book. "The job is to continuously and intently monitor the information on the screens all night long," said one official. "It is much safer and more efficient if operators closely manage the process rather than let the plant bounce back and forth between high and low alarms." In reality, of course, the operators' job consisted of 99.9 percent boredom and 0.1 percent terror.

The managers and engineers who wrote the official job descriptions had never stopped to consider the pressures on the human body during the nighttime hours. The equipment and management systems for that plant had all been designed during the daytime by people who were not constantly reminded of the fatigue suffered by those who work shifts around the clock. They assumed that the operators would stay alert, not recognizing that they had created a work environment where the operators were bound to fail.

These managers and engineers are not alone. Our society as a whole treats machinery better than the bodies and brains of the people who run it. A manager of an industrial plant, the pilot of a plane or space shuttle, and the captain of an oil tanker would be deemed reckless if they operated a complex machine outside its design specifications. Yet the most sophisticated piece of equipment in that plant, aircraft, or tanker—the human operator—is routinely pushed beyond its limits.

Although people don't emit smoke or grind gears, they do show analogous signs of breakdown. People who work in round-the-clock industries suffer a higher rate of illness and death than those who work on straight day shifts. What's more, the major industrial accidents of our time have been rooted in fatigue caused by asking people to perform outside their "design

specs." Investigators have concluded that Chernobyl, Three Mile Island, and the Swiss chemical spill that poisoned the Rhine in 1986 probably would not have happened if those responsible had been alert and well rested. In the *Challenger* disaster, NASA officials made the ill-fated "go-no go" decision under the stress of staying awake for 20 hours after only 2 or 3 hours' sleep the night before.

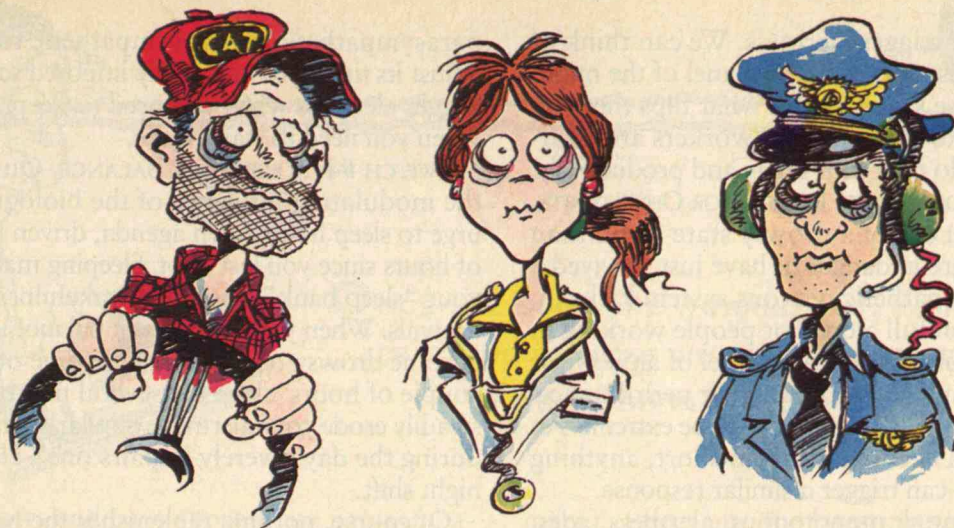
But the problem is far broader than just a few notorious accidents. In our finest teaching hospitals, the wonders of high-tech medicine are rendered useless by the errors of frazzled interns and residents on 36-hour shifts. On our highways, long-haul truckers work such irregular, sleep-disrupting schedules that accidents in the hours just before dawn climb to 15 times the daytime rate. And pilots worn out by long, monotonous hours in the cockpit, their brains jumbled from crisscrossing time zones, inadvertently nod off in the cockpit and drift off course, or land on the wrong runway.

Fatigue is endemic to our nonstop 24-hour society, in which large sections of the population now work at night or on rotating shifts. And it is only going to get worse. Competitive pressures are forcing more and more businesses to provide services 24 hours a day. Demands for higher returns on capital investment and lower costs are requiring most manufacturing plants to convert to round-the-clock, seven-day-a-week operation. International competition, enhanced by modern telecommunications, is speeding up the pace of global trade and the demand for international travel. Because it is always daytime somewhere in the global village, those working on the bright side of the planet create a demand for instant attention from others who have to work on the dark side.

The risks of fatigue are being compounded by the trend toward placing ever more power in the hands of individual workers. Oil refineries are centralizing their computerized control systems so more distillation towers and cracking units can be run by a single operator. Chemical plants are converting from batch processing to continuous processing so more chemicals can be synthesized with fewer employees. Trucking companies are adding double and triple rigs so more goods can be transported by a single driver. Aircraft companies are designing the next generation of superjumbos to carry more passengers with a smaller crew. Today, human errors that used to cost hundreds or thousands of dollars can cause damage into the millions or even billions.

Human error has become the problem of our age in large part because so many workers are subjected to schedules and environments that ignore the design specs of the human body and defy the natural circadian rhythms that control sleeping and waking. The only way out of this predicament—short of banning night work and seceding from the global economy—is to adopt working conditions and routines that are human-centered instead of machine-centered.

MARTIN MOORE-EDE is an associate professor of physiology at Harvard Medical School and director of the Institute for Circadian Physiology in Cambridge, Mass. He also heads Circadian Technologies, a consulting firm. His book *The Twenty-Four-Hour Society: Understanding Human Limits in a World That Never Stops* was recently published by Addison-Wesley.



HUMAN ERROR HAS BECOME THE PROBLEM OF OUR AGE BECAUSE SO MANY WORKERS ARE SUBJECTED TO SCHEDULES THAT IGNORE THE BODY'S "DESIGN SPECS."

Thanks to recent scientific and technological advances, it is now possible to do just that. The field of sleep and alertness neurophysiology has yielded important insights into the causes of fatigue. And research and consulting firms are developing techniques that can sustain workers' alertness and performance around the clock. For example, at the Institute for Circadian Physiology, a nonprofit research center my colleagues and I established in Cambridge, Mass., in 1987, volunteers work full-length day and night shifts at consoles identical to those in industrial control rooms and then sleep and relax in apartments where we have complete control over temperature, light and dark, and other aspects of the environment. Through such research, a new field known as human-alertness technology has begun to emerge. Alertness-modeling software, monitoring equipment, and systems for automatically adjusting the work environment are among the keys to a safer, more productive workplace.

The Nine Switches of Alertness

Alertness is the optimal activated state of the brain, when it hums and purrs and when creative solutions to old problems pop into the mind. It is alertness that lets us make conscious decisions about what to pay attention to in our environment and what to screen out. And it is alertness that keeps us out of trouble—on the highway, in the cockpit, on the factory floor or the trading floor.

It is only in recent years that we have come to learn how an elegantly engineered clock deep in the hypothalamus of the brain governs alertness. The suprachiasmatic nucleus is a tiny cluster of nerve cells, smaller than a pinhead, that regulates the timing of our bodies, including cycles of sleep and wake. This biological clock

keeps track of the time of day and the seasons of the year, and marches our bodies and brains in step.

Formed over millions of years of evolution, the suprachiasmatic nucleus is ill suited to the world of night work. For under the pull of our biological clocks, most types of human performance—including manual dexterity, mental arithmetic, reaction time, and cognitive reasoning—are significantly impaired during the nighttime hours. Each type of performance typically heads downward at bedtime and then recovers during our internal reveille at dawn. That is not to say we cannot function at night. We are simply more prone to making dumb mistakes.

The suprachiasmatic nucleus appears to work its effects through the body's two "autonomic," or automatic, nervous systems. In the words of Walter B. Cannon, the Harvard Medical School physiologist who first described them at the turn of the century, these nervous systems regulate all the essential functions "nature saw fit to remove from the caprice of an ignorant will."

The sympathetic nervous system is the one automatically triggered in the face of danger: it makes the heart pound, the blood pressure rise, the pupils dilate, and the hair stand on end. This is what Cannon graphically described as the "fight or flight response." Alertness is at its peak when the sympathetic nervous system is fully activated.

The counterbalancing mechanism is the parasympathetic nervous system, which switches you into a relaxed state, constricting the pupils and decreasing the heart rate and blood pressure. Here alertness is at its lowest ebb.

The balance between these two nervous systems, and hence our alertness, depends on a variety of factors, of which our circadian clocks are but one. In fact, researchers have identified nine key internal and exter-

nal conditions that trigger alertness. We can think of them as the switches on the control panel of the mind. Understanding these switches and what flips them on or off is the secret to ensuring that workers are clear-headed enough to do their jobs safely and productively.

SWITCH #1: SENSE OF DANGER, INTEREST, OR OPPORTUNITY. Nothing snaps you out of a drowsy state faster than realizing that you are in danger or have just survived a near miss. The sympathetic nervous system kicks in, placing the brain on full alert. For people working in "safety-sensitive" jobs, a controlled level of anxiety (or at least concern) can help optimize their performance. But the stimulus does not always have to be extreme. An interesting task, an exciting idea—in short, anything new and different—can trigger a similar response.

If the job is boring or monotonous, alertness fades. The too familiar—the endless stretch of highway across the western desert or the night shift in a plant when everything is running smoothly—triggers parasympathetic drowsiness.

SWITCH #2: MUSCULAR ACTIVITY. Mild activity such as taking a walk, stretching, or even chewing gum is known to help keep people awake. And vigorous activities like running or lifting weights can stimulate alertness for at least an hour afterward. That's why it is so hard to fall asleep right after a jog. The trouble is that many of the most dangerous tasks in our society—driving a car, flying a plane, directing air traffic, or running a nuclear power plant—are sedentary.

SWITCH #3: TIME OF DAY ON THE CIRCADIAN CLOCK. Alertness cycles systematically and logically throughout the day as your biological clock wakes you up by activating the sympathetic nervous system, then starts shutting you down by ratcheting up the parasympathetic system. These mechanisms, so perfectly attuned to the traditional pattern of daytime wakefulness and nighttime rest, get us into trouble in our 24-hour world. The biological clock, and therefore the coordinated cycle of

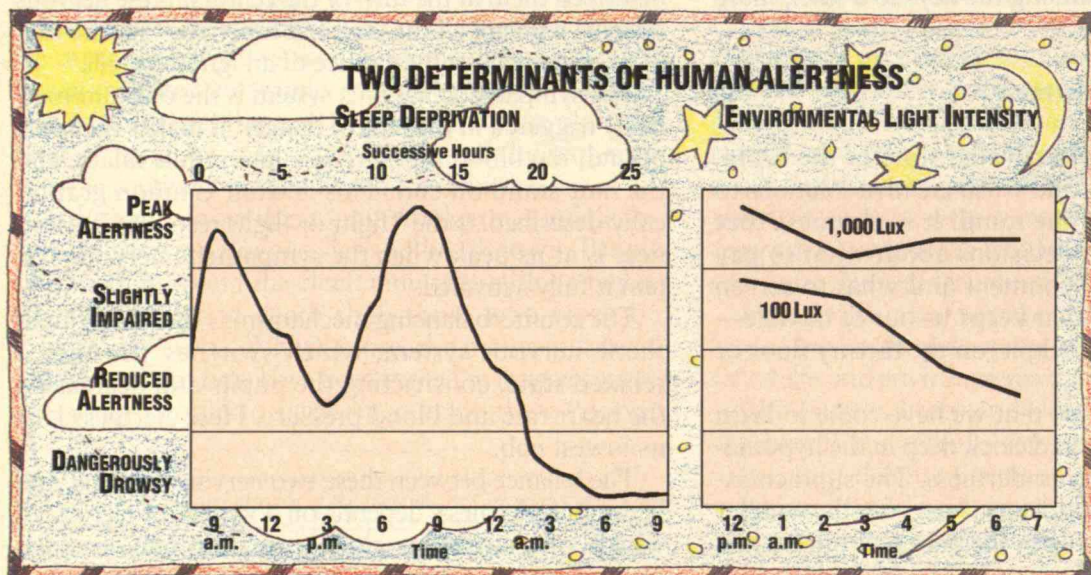
parasympathetic versus sympathetic tone, is slow to adjust its timing to any newly imposed schedule: it may trigger alertness when you need to sleep, and sleepiness when you need to stay awake.

SWITCH #4: SLEEP BANK BALANCE. Quite aside from the modulating influence of the biological clock, the urge to sleep has its own agenda, driven by the number of hours since you last slept. Sleeping makes deposits in your "sleep bank"; sustained wakefulness makes withdrawals. When your sleep bank balance is low, you will become drowsy regardless of the time of day. Losing a couple of hours' sleep for several nights in a row will steadily erode your alertness. Similarly, inadequate sleep during the day severely impairs one's alertness on the night shift.

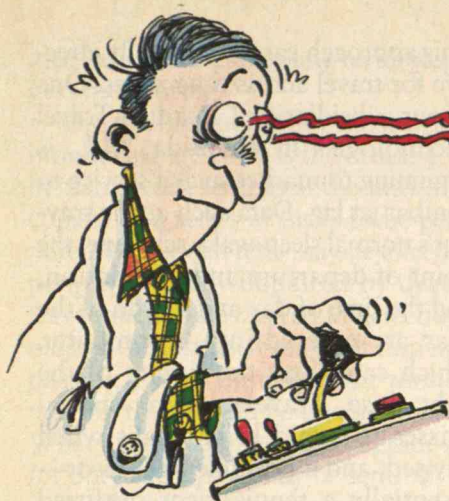
Of course, nothing replenishes the balance in your sleep bank account like a good night's sleep, but strategically placed catnaps of 10 to 15 minutes each are effective as well. Indeed, they restore alertness much more efficiently than longer naps, making it possible to dramatically reduce your total sleep in a 24-hour period.

SWITCH #5: INGESTED NUTRIENTS AND CHEMICALS. Alertness may be altered by the chemicals and nutrients that one ingests or inhales. While a heavy meal may induce parasympathetic drowsiness, the act of snacking may help keep you awake—as will various licit and illicit uppers. This is often a maladaptive way to force alertness on a fatigued brain, but it is a common prop in round-the-clock operations. Shift workers drink pots of coffee, not cups. Truckers take amphetamines to keep going, and in more innocent days hospital interns would revive themselves with small sniffs of cocaine. One of the biggest problems with pharmacological strategies is that the brain chemistry rapidly adapts so that larger and larger doses are needed to have the desired effect.

SWITCH #6: LIGHT. Restaurateurs have played with the effects of lighting for years. In the expensive restaurant



People's alertness bottoms out toward dawn if they are deprived of sleep (far left). This problem is compounded by the dim nighttime lighting of many work environments—often 100 lux or lower—but can be countered by special bright lighting systems that put out 1,000 lux (left).



ONCE THE BUGS ARE WORKED OUT, INFRARED EYE-TRACKING DEVICES WILL MONITOR ALERTNESS UNOBTUSIVELY AND PRECISELY.

where one lingers and pays appropriate parasympathetic homage to a gourmet meal, the lights are turned down low, and the pace is slow. Fast-food places are brightly lit, encouraging fast eating and fast departure. Even brighter lights—at least 1,000 lux (the level of outdoor light just after dawn)—can dramatically suppress sleepiness on the night shift, keeping workers in a state of sympathetic activation. Unfortunately, industrial workplaces tend to be lit at only 10 to 100 lux at night—levels that do nothing to stimulate alertness.

SWITCH #7: TEMPERATURE. It is common experience that cool, fresh air, especially upon the face, rouses one from a sleepy state. Sultry heat has the opposite effect, which is why it makes little sense for industrial plants to keep workers toasty at night.

SWITCH #8: SOUND. Sound can invigorate or it can lull you to sleep. Rolling surf or the smooth rushing of a mountain stream is so relaxing that these sounds are now electronically simulated in “white noise” machines that many people use in their bedrooms. Yet the equipment in industrial control rooms that people are meant to watch intently through the night produces the same electronic white noise. In contrast, irregular or variable sound—like the intermittent creaking of a door gusted by drafts in the middle of the night—will help keep you awake. That is why a car radio can be a godsend when one is driving alone on a sleepy afternoon, and why banning radios from an industrial control room when all is humming quietly in the middle of the night is a prescription for human error.

SWITCH #9: AROMA. Although less research has been done on olfactory stimulation than on the other eight factors, reports and claims are starting to appear that certain aromas such as peppermint make people more alert.

Through the best of intentions, most industrial workplaces flip these switches of alertness in the wrong direction. One reason is that the human desire for comfort tends to take precedence over the need for alertness. The cozy chemical-plant scene described earlier is duplicated all over the world in air traffic control towers, military installations, power plants, and oil refineries. To make matters worse, engineers are striving to build

more comfort into the latest planes, process control panels, truck cabs, and railroad engines in the mistaken belief that comfort improves performance. The truth is that to be fully alert one has to be a little uncomfortable, especially in the wee hours of the morning.

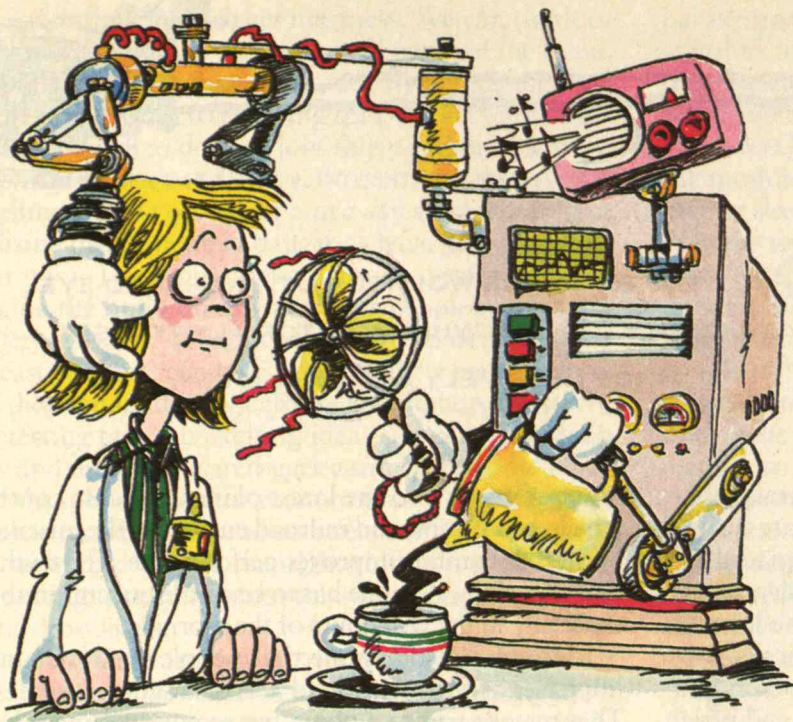
Managers also assume that people's performance improves as their workload and distractions decrease. That may be true to a point, but remove too many distractions, reduce the workload too far, and monotony sets in. With little to do in the middle of the night, waves of sleep can too easily descend and reduce performance to zero.

Human-Alertness Technology

The missing element in the design of most equipment, systems, and work spaces for round-the-clock operations is human-centered technology that optimizes alertness, and therefore performance, at any time of day or night. Such technology, based on an understanding of how to manipulate the nine physiological switches of alertness, consists both of methods for helping people cope better with shiftwork and of equipment that makes shiftwork easier to cope with. Both approaches are now being adopted in a variety of industrial workplaces.

Training programs can teach people who work rotating or irregular shifts to adjust their sleep patterns and thereby optimize their alertness at work. Workers can learn strategies for getting better daytime sleep—say, by installing darkened blinds, arranging ways to keep their families quiet, and encouraging spouses to form support networks for peace of mind during their partners' absence.

It is also possible to design more enlightened work and rest schedules that are compatible with the human biological clock. For example, managers can shift employees' work hours gradually, rotate hours clockwise—the direction in which the body is better able to adapt to the night shift—and allow enough days off between changes in shift. One way to gain this extra time is to adopt a 12-hour work day and a work week that alternates between three and four days.



TECHNOLOGIES THAT AUTOMATICALLY ADJUST WORKERS' "ALERTNESS SWITCHES" WILL BE THE KEY TO DEVISING A TRULY HUMAN-CENTERED WORKPLACE.

Computer modeling of the processes that determine alertness can help consultants identify the risks of a specific job or shift and suggest modifications. By plugging in numbers for such variables as circadian time of day and number of hours of sleep the previous night and over the previous week, we can predict how error-prone a given worker is likely to be.

We can also manipulate the work environment to set the alertness switches of light, temperature, sound, and aroma to their optimal positions. Furthest advanced is our knowledge of how to use light. People turn down the lights at night to avoid the discomfort of glare from reflective surfaces. Instead, they should be turning *up* the light (to at least 1,000 lux) and engineering the glare out of their environment. Computers can be equipped with nonglare screens, stainless steel coverings can be coated with a matte finish, and lights can be placed where they are not reflected into people's eyes. In test-bed utility and chemical-plant control rooms where we have reduced glare and installed bright lighting, we have seen dramatic improvements in operators' ability to function on round-the-clock schedules. They not only perform better on reasoning tests, for example, but have trouble falling asleep even if they try.

Controlled exposure to still brighter light (3,000 lux or more) can actually reset the natural patterns of sleep and wake that are driven by the brain's circadian clock.

This approach can be especially effective for travel across time zones. One of our subsidiaries, Circadian Travel Technologies in Bethesda, Md., is beginning to market such a service to combat jet lag. Data such as the traveler's normal sleep-wake schedule, the point of departure and destination, and the time of day and season of the year are entered into a computer, which calculates the timing of the light dose. Travelers wear special glasses to avoid bright light when advised, and a portable light visor—essentially a tennis visor outfitted with two small halogen lamps that illuminate (but do not shine directly into) the eyes—provides the timed light dose. This technique brings a person's internal body time rapidly into sync with the new time zone.

The very-bright-light approach can also be used to reset the circadian clocks of shiftworkers each time their schedule changes. At least one firm, Light Sciences in Braintree, Mass., has installed lighting systems of 3,000-plus lux at industrial plants. The problem is that once you use very bright light to shift people to a

new schedule, you take on the responsibility of switching them back so they can resume their personal schedule on their days off. Not only have reports of difficulty in readjusting begun to surface, but the long-term effects of such weekly clock shifting are not known. While a frequent flyer might require a handful of clock resettlings a year, a person rotating between day and night work every three or four days, as many do, may have to shift nearly 50 times a year.

Just as effective, in my view, are moderately bright (1,000-lux) light systems that suppress drowsiness without significantly resetting the biological clock. Many small manufacturers have developed compact "light boxes" that deliver this level of illumination for individual use, and we are now installing this technology in a variety of industrial control rooms.

Similar methods are under development for controlling temperature, sound, and aroma. The Japanese construction firm Shimizu, for example, has developed special conference rooms where not only are light and temperature regulated but also special ventilation systems periodically waft specially crafted smells to stimulate alertness.

Such efforts to optimize the workplace are all well and good in theory, but in safety-critical work someone—or something—still has to make sure all the safeguards against drowsiness are doing their job. This is the

idea behind the expanding technology of "human-alertness monitoring."

The most popular but most primitive approach to monitoring alertness is the fitness-for-duty tests applied in many work settings at the start of a shift. These often consist of a series of tasks to be performed on a computer. While such tests may be effective for screening out people seriously impaired by drugs or alcohol, they leave much to be desired in detecting fatigue. The stimulus of the test itself may jolt impaired individuals into passing it even though in the monotony of their normal job they would be unable to perform satisfactorily. What's more, alertness can degrade rapidly: someone fit for duty at 11 p.m. may be seriously impaired by 3 a.m.

In jobs where lives are at stake, the only reliable solution is to monitor a worker's alertness continuously. One way of doing this is to track brain waves and eye movements, both of which can serve as windows into a person's alertness. Brief "microsleeps" intruding into the waking state, slow rolling eye movements, and changes in blinking patterns are telltale—and measurable—signs of drowsiness. Researchers have wired up workers in a range of occupations with scalp electrodes and portable Walkman-sized electroencephalogram (EEG) and electrooculogram (EOG) recorders to detect changes in brain waves and eye movements throughout the normal workshift.

But several challenges must be met before such alertness monitoring can become feasible for everyday use. First, the measurement must be unobtrusive so it doesn't interfere with the job. Second, it must be done in a way that doesn't require a trained technician. Third, deteriorations in drowsiness must be detected quickly (ideally within seconds) so that warnings or countermeasures can be triggered fast enough to be useful in driving or flying. Fourth, the system must be highly reliable. False negatives could have serious consequences, especially if workers come to rely on the system to monitor their alertness. False positives will cause irritation and tempt people to deactivate the system. Fifth, the equipment must be small and light enough to carry around or fit in a cramped vehicle. And sixth, it must be inexpensive enough to install in millions of critical human/machine interfaces.

Two approaches seem promising in this regard. One, being developed by an Israeli manufacturer, uses a lightweight EOG monitor resembling a telephone headset, with sophisticated electrodes that do not need to be pasted to the head. A person's eye movements can be analyzed in real time by software that looks for symptoms of drowsiness. An individual with such a headpiece can move about freely, although the software still needs to be refined to screen out artifacts of muscle activity.

Even less obtrusive are devices that reflect an infrared beam off the cornea to track eye movement, line of gaze, blinking, and other ocular measures of alertness. Such

eye-tracking technologies have been used in ergonomic research on the design of cockpits and other human/machine interfaces, but the challenge is to develop them into effective alertness monitors. One task is designing reliable algorithms—in other words, figuring out which ocular variables are the surest signs of drowsiness. Another is overcoming these systems' limited field of view. A possible solution is to use servo-tracking cameras that follow your eyes as you turn your head.

Once the bugs are worked out, eye tracking will provide a monitoring technique that is truly unobtrusive, that doesn't require workers to wear a special device, and that is so specific in its monitoring that it can determine whether the person has read an instruction or warning in one corner of a computer screen.

The Human-Centered Workplace

The short-term goal of alertness monitoring is to sound some kind of alarm when an individual is becoming dangerously impaired. A system might warn the individual, a supervisor, or a colleague, or perhaps signal the worker's computer to assign a test task that would prove whether the person was alert. But suppose the system didn't have to tell anybody. One of the most exciting areas of technological development seeks to adjust workers' alertness switches automatically. This will be the key to devising a truly human-centered workplace.

Imagine a future operator seated at the controls of a high-tech facility in the wee hours of the morning. Although she is well trained in sleep and alertness management, the work is monotonous that night and her alertness starts to wane. Unobtrusive infrared eye-tracking technology or a lightweight head-mounted monitor picks up the first signs. Without her noticing, the brightness of the illumination in her glare-free room is automatically adjusted upward, and the stratum of air at head level is cooled. At the same time, a stimulating aroma wafts into the room while the computer flashes a low-priority but interesting task onto her screen. Instead of slipping into a zombielike state, she is restored to full alertness and is now capable of functioning well in the event of a plant malfunction.

All the separate bits and pieces of such a system have reached at least the prototype stage. We simply need to refine them and combine them into a smoothly coordinated work environment. When such technology becomes a standard feature of 24-hour operations, our society will finally have reversed the tendency that leads to so many industrial breakdowns and disasters: we hire the weak link in the chain to watch the strong link. Instead of regarding human error as an inevitable consequence of technological development, we need to make sure the strong link can watch the weak link as well. ■

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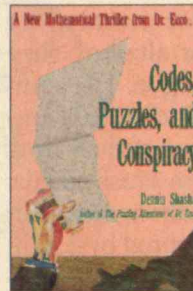
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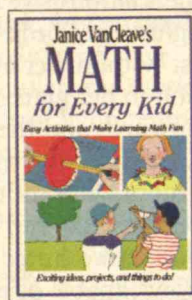
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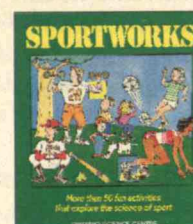


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What the Doctor Prescribes

AN INTERVIEW WITH BERNADINE HEALY



IN March 1991, Myron L. Weisfeldt, an old friend of Bernadine P. Healy and now chief of medicine at Columbia University's College of Physicians and Surgeons, accurately forecast the tenor of the coming two years at the National Institutes of Health. "If you are at the NIH, make sure you have a seatbelt," he told the *Washington Post* about the new appointment of Healy, a cardiologist, to oversee the world's largest biomedical-research agency. "When

HAVING JUST LEFT THE
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things are moving that fast, you want to make sure you are protected."

The agency, which awards grants to about 20,000 principal investigators and employs 19,000 people (including 4,500 researchers) of its own—for a total budget of more than \$10 billion—became steeped in one controversy after another during Healy's tenure, which ended this past July. For instance, should NIH request patents on thousands of clones of partial gene sequences even though their functions are largely unknown? Healy claimed that doing so might encourage technology transfer and hence product development. Critics predicted the opposite. Should NIH develop a "strategic plan," a major goal of Healy's that she saw through to publication? Some scientists warned about the occasionally unplannable course of scientific research, while others praised the idea as overdue. And can NIH's \$625 million, 15-year Women's Health Initiative, a research effort that Healy announced during her first month in office, answer all the questions it poses? Several experts charged that the study, as designed, probably can't resolve a key question—whether a low-fat diet reduces the risk of breast cancer—and suggested that the funds would be better spent on other studies. Healy refers to the protocol's economies of scale, points out that the study is considering interactions among a wide variety of diseases and interventions, and says that the critics have a vested interest in narrower projects.

Healy's willingness to take strong stands elicited admiration among her troops. "You have no idea how much work the strategic plan took," says Caroline Hollaway, director of Office of Science Policy for NIH's National Center for Research Resources. "We really felt the excitement; we all got behind her." And Gabriel Bialy, special assistant to the director of the NIH Center for Population Research, says he values that she "was the first director of NIH willing to put her name to an article dealing with contraception."

But Healy also displeased some people too. James D. Watson, a Nobel laureate who helped elucidate the structure of DNA, quit his NIH post as head of human genome research, claiming in the *Washington Post* that Healy seemed not to want him in office. Rep. John D. Dingell Jr. (D-Mich.) showed repeated irritation with Healy about matters related to cases of alleged scientific misconduct. And some members of the Congressional Caucus on Women's Issues, including Rep. Patricia

Schroeder (D-Colo.) and Rep. Louise Slaughter (D-N.Y.), took umbrage when Healy decried language in an NIH reauthorization bill that she believed would have compromised research on women's health.

Now that Healy has returned to the Cleveland Clinic Foundation, whose research institute she had previously headed, can those people who focus on national biomedical-research policies remove their seatbelts? Maybe not: In late summer Healy said there was an "extremely high probability" that she would run for the U.S. Senate in Ohio, to fill the seat to be vacated by Democratic Sen. Howard M. Metzenbaum. In a recent interview with senior editor Laura van Dam, Healy spoke about the hand she thinks NIH is being dealt these days and, not surprisingly, called on scientists to enter the political fray.

TR: During your tenure as NIH director, one of your major goals was developing an explicit overall agenda for U.S. biomedical research. Why did you receive so much flak for that from some quarters?

HEALY: The strategic plan topped my list of initiatives for bringing together the biomedical-research community—meaning both agency employees and outside scientists who receive NIH funding. The plan's purpose was to explain why the agency is important to the American public and to lay out the issues NIH must embrace. While it was constructive for members of the community to address those issues, the plan had its controversy. There always will be a fundamental difference of opinion as to whether such a plan is antithetical to an organization involved in exploring uncharted waters. I believe a plan is essential since you still must know why you are in the waters and where you need to go.

TR: The plan seems to identify virtually all current research as a priority. I have trouble seeing what is *not* in the plan.

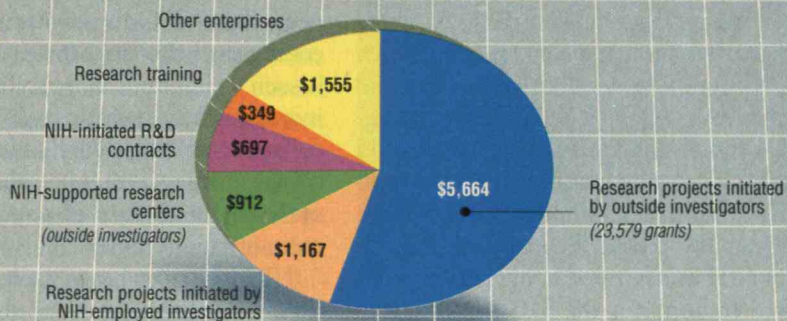
HEALY: Given NIH's mandate, virtually every important area of research on human disease and in the life sciences is in the plan, but you have to look at where it introduces new priorities. One that warms my heart is research on the health of women. There are many unacceptable knowledge gaps about women's health that must be closed. For example, we have a woeful lack of knowledge in the areas of contraception, sexually transmitted dis-

NIH Research Funding in the Federal Bureaucracy

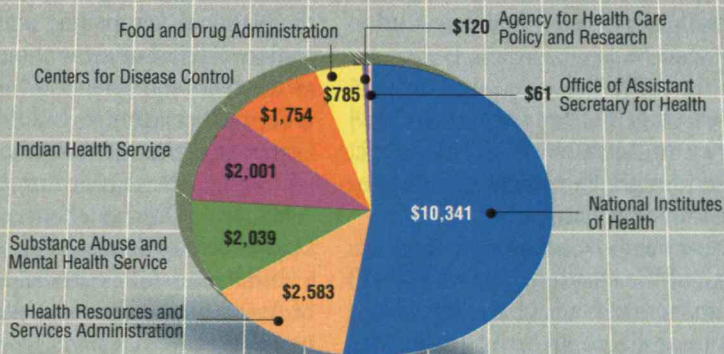
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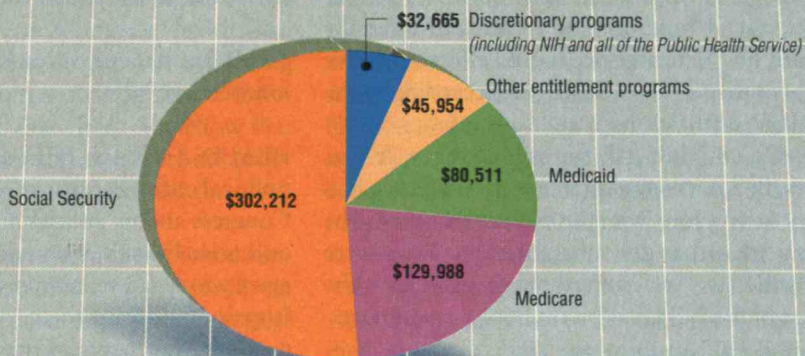
How NIH Divides Its Pie



How NIH Fits Within the Public Health Service



How the Department of Health and Human Services Divides its Pie



The budget for NIH, the rest of the Public Health Service, and other discretionary programs is a small fraction of the money controlled by the Department of Health and Human Services.

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eases, and estrogen replacement therapy for women in menopausal years and beyond.

The most important aspect of the strategic plan is that the agency has started to do things differently because of it. Consider the priority given to basic biological research related to the environment. NIH's portfolio of grants in environmental health sciences to outside researchers is slated to double over the next three years.

But two things are absent from the plan that would drive a corporate CEO to distraction. One is that there's no ability to deal with NIH's organizational structure. I believe you could improve that and save somewhere between \$50 million and \$200 million, much of it by streamlining administrative work and reducing overhead. But that would require legislation, which the executive branch would have to initiate and Congress would have to pass. The second thing is a budget. The bottom line needed to breathe life into fulfilling the goals of NIH as described in the plan is probably \$15 billion, not the \$10.3 million the agency had in fiscal year 1993, which was for the most part rigidly allocated according to congressional mandate.

TR: That much more money could be hard to come by these days.

HEALY: Certainly. Yet for fiscal year 1994 Bush's Office of Management and Budget (OMB) asked for an 18 percent increase for NIH—an astounding victory for us.

But it turned out to be only a temporary victory because of the election. The new OMB started from scratch and basically asked Congress to pass a zero-growth budget, with six or seven presidential priorities for specific areas such as breast cancer and AIDS grafted on. We were just told how much money would go to each of those areas. Meanwhile, most other research areas saw a 1 to 2 percent decrease in funding. And some were especially hard hit. Neuroscience would effectively have to contract by 5 to 6 percent, according to the administration's request.

We couldn't ask for any changes. It was detailed micromanagement of a type we had not seen before from the executive branch. The few areas that got substantial increases were justified as "investment programs." As if the rest of the NIH contract is not an investment.

TR: How could the process for setting the NIH budget be improved?

HEALY: I think NIH should be made an independent agency, separate from the Department of Health and Human Services (HHS), so it can deal directly with OMB and the White House. Some of the things put in the NIH budget are so problematic that if the NIH director could routinely sit down with the director of OMB or somebody at the White House, the result would likely be different.

NIH suffers seriously from being buried in a giant entitlement agency. NIH's scientific programs compete against vaccine programs for children, Head Start programs, and clinics on Indian reservations. The comparisons are inappropriate. NIH is an investment and not an entitlement program. Moreover, because HHS is such a circuitous maze, NIH regularly gets incredible bureaucratic bashing. Creating or collapsing an office—or making even the most trivial organizational change—requires months if not years of approvals from the maze of offices above.

NIH is also too big an agency to be carrying a giant battleship on its head—the combination is simply unwieldy. In fact, if you look at all the independent federal agencies—there are more than 100—the size of NIH's budget would make it the second largest, right after the National Aeronautics and Space Administration. NIH's budget is about three times that of the National Science Foundation, also an independent agency. NIH's budget is even larger than that of several cabinet agencies, including the Environmental Protection Agency, the Department of Education, and the Department of State.

NIH's mission is crucial to the well-being of Americans—in terms of health and the economic growth that stems from such industries as biotechnology and pharmaceuticals. It needs more direct access to both the executive branch leadership and Congress. Back-door access—its present alternative—often occurs in a chaotic, undisciplined way.

TR: What structure would you set up for an independent NIH?

HEALY: Although NIH can't help but be a political entity because it gets its budget from Congress and its policies are developed by the executive branch, it should not be a partisan agency to whatever administration is in power. It's too important to everybody. I support a term appointment for the NIH director that does not coincide with presidential election years. And there should be a board of gover-

nors chosen through a selection process similar to that of the Federal Reserve, in which the president appoints members for a limited period subject to congressional approval.

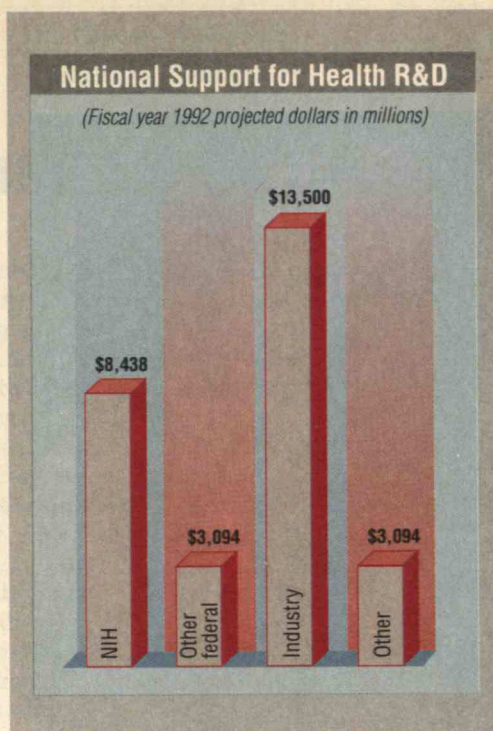
TR: Some observers say that the agency became highly politicized during your tenure.

HEALY: A number of political issues were grafted onto the agency inappropriately. In early 1993, for example, the bill to reauthorize NIH was held up over whether people who have the AIDS virus should be allowed to emigrate to the United States. Why in the world should Congress have attached an AIDS immigration ban to the NIH bill? The agency has no involvement in that issue. I found it absurd that President Clinton signed that bill this past June, after he repeatedly said he was against such a ban. In any case, that reauthorization bill is not one we need; it is meddlesome. The detailed bureaucratic requirements the bill imposes will make the agency's job more difficult. It requires, for example, new committees, commissions, and reports—and the agency is already overloaded with all three. NIH has more commissions and committees than any other agency in government.

TR: You also opposed the first version of the NIH reauthorization bill for another reason. In a letter to HHS secretary Louis Sullivan in May 1992, you said you would support a recommendation that President Bush veto the bill, in part because it required particular efforts concerning research on women's health. You wrote that NIH had "moved ahead" of the bill with "aggressive programs" in that area. But why weren't you interested in getting all the help you could there, when you've shown such strong interest in women's health all along?

HEALY: Dr. Vivian Pinn, the head of the Office of Research on Women's Health, also opposed a provision in the bill regarding women's health research and sent a letter along with mine to that effect. Somehow that letter and both of our concerns were not properly noted as reasons for supporting the president's veto.

The bill would have been fine if it had simply mandated the Office of Research on Women's Health, which was started to make sure that the gaps in women's health research and in the development of women scientists' careers were being addressed. But the bill



After industry, NIH provides the biggest chunk of money nationally to support R&D on health.

would have required that the office basically become a bean-counting operation, with direct responsibility for monitoring virtually every NIH grant for whether possible gender differences were important to examine, and if so, whether that aspect was properly dealt with. You can't have a small office with just a few people monitoring 20,000 grants. That responsibility has to be placed on the shoulders of individual institute and program directors.

Another problem in that version was that the bill's imposition of gender quotas on almost all scientific research was scientifically flawed. For instance, if the agency did a clinical trial on some intervention for breast cancer, then to determine gender differences in response to the intervention, NIH would have had to make sure enough men were in the trial. For sufficient statistical power, scientists would have had to increase the numbers of research subjects to astronomical heights. It would become almost impossible to do a study: the cost of the study would become prohibitive; and the results would retard our ability to get needed information on breast cancer in women. So that requirement was a foolish part of the bill. Congressional law is not the place for dictating scientific methods.

In the next version of the bill, we finally were able to get that requirement partly modified, although it still has problems. But in the process of objecting I took a lot of heat. Some of the women in Congress attacked me for



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selling out women. Rather than admitting that the language was flawed, they covered up the real issue and somehow tried to portray me as not interested in women's health. That's another example of the partisan politics that neither NIH or the NIH director should have to confront. At the very outset, even during the drafting of the bills, the dialogue on NIH legislation should have included NIH leaders. Congress and the administration repeatedly left the agency out of most of the discussion on this bill and most bills affecting NIH.

TR: In terms of your relationship with Congressional members, do you think Rep. John Dingell stepped too far into NIH's affairs with his subcommittee's examinations of how the agency's Office of Scientific Integrity (OSI) investigated alleged misconduct?

HEALY: My biggest concern is that the real facts of those scientific-integrity cases didn't always come out. The facts were often distorted as they passed through the lens of his subcommittee. The involvement of subcommittee staff members at times almost usurped the responsibilities of executive-branch agencies trying to perform investigations. His subcommittee acted as Big Brother—watching every minute—making it difficult for OSI to handle cases objectively.

TR: Many scientists might look at the political battles you took on during your NIH years and decide that they'd rather stay close to the lab bench. What's your perspective?

HEALY: Working scientists and academic administrators need to engage the political process in a more informed and direct way because it is increasingly going to affect their lives and their ability to do their work. There is a tendency to react to but not participate in issues, and by then they're often lost. Every researcher, for example, should ask his or her legislators why there wasn't more of a cohesive justification behind the significant changes in the Clinton administration's NIH budget proposal for this fiscal year.

Researchers also have to back away from any tendency to respond to limited information in an ideological way—which is the antithesis of how science should work. Consider the strategic plan. On its face it appears to come in conflict with the ideology that we all agree with—that science is about the unexpected. But even if you're in uncharted waters and you're confronting the unexpected, you still have an obligation to know exactly why you are there and in a general way where you want to go. And you have to be able to articulate these notions to 250 million Americans who are paying the price of your voyage. You shouldn't use an ideology as a reason for turning your back on that responsibility.

You have to try to apply the scientific method to sorting through the policy issues confronting science. Instead of just turning a hypothesis into a fixed belief, you have to look at all the information and use the same logical thought process that you would in scientific research. Scientists should not allow themselves to have an unexamined, ideological response.

TR: What advice do you have for your successor?

HEALY: I don't think it is right to give specific, concrete advice—then I would be trying to micromanage. Instead, I'd just say that after you do your homework, have the courage to stand up for what you think is right. It's often difficult to make a decision that you know a certain number of people will criticize you for, but a non-decision is a decision as well. ■

Thoughts Along the Nile

AN engineer traveling in Egypt cannot help but feel like a pilgrim returning to an ancestral shrine. This fascinating land has long attracted all sorts of tourists from all over the world, but for an engineer it has a special resonance.

This is where it all began, I mused, as our river boat drifted downstream with the Nile current during a recent trip. This is where humans learned to join irrigation canals into large networks, to build dikes and watergates, to work cooperatively in creating agricultural abundance for a large population. The energy thus liberated was then applied to building some of the most monumental structures the world has ever seen. This is where engineering was born, and with it the beginnings of civilization as we know it.

Of course, many engineering techniques originated in places remote from the Nile Valley. But if we think of engineering as a group activity, with an important social and political component, then surely Egypt can claim a special priority. More than 5,000 years ago, along 700 miles of the fabled river, the Egyptians were united under a single ruler and engaged in hydraulic engineering on a massive scale.

I found the famous antiquities—the pyramids, the Sphinx, the temples at Karnak, and many others—every bit as awe-inspiring as the travel books say they are. I know that some chroniclers of Western culture have been disenchanted by the notion that these magnificent works were built by slaves and inspired by the dread of death. Yet, according to many of today's Egyptologists, such presumptions have been erroneous. During the months when the river was in flood, making it impossible to perform agricultural chores, large numbers of farmers were available to work on construction projects. Consequently, the tombs and shrines were the public works of the day, built largely by free people.

As for macabre theories about crypts and burial artifacts, historians are also having second thoughts. They suggest that the Egyptian interest in an afterlife

stemmed not from fear and anguish, as in many cultures, but rather from a zestful fondness for life itself. Indeed, the splendid structures bespeak a radiance of spirit that cannot help but enchant the visiting engineer.

I was pleased to find that some of the engineers responsible for the great works are known to history and accorded full credit. Around 2950 B.C., Imhotep—prime minister to the Pharaoh Zoser, and the first engineer whose name is recorded—built the famous step pyramid at Sakkara. Centuries later, the Egyptians elevated Imhotep to their pantheon of gods.

In a tomb at Abydos, dating from about 2500 B.C., an inscription attests that a hydraulic specialist known as Uni held, among other offices, that of "Superintendent of the Irrigated Lands of the King." Grandest of all, perhaps, was Ineni, "chief of all works in Kar-

ecology of the Nile Delta. As the water table rises in the sandy soil downriver from the dam, moisture seeps into precious, age-old monuments, threatening serious damage.

Fortunately, corrective action is being taken. Say what one will about technological fixes, it is gratifying to see silt being removed from the upstream side of the dam and spread over barren desert to create new cultivatable land. And one of the highlights of an engineer's trip are the temples of Abu Simbel, salvaged in 1963 and rebuilt on high ground as the impounded waters rose behind the new dam. New drainage schemes and protective coatings are being developed to spare the ancient monuments from the ravages of moisture.

The ancient Egyptians, stirred by a primal impulse, grappled with nature in pursuit of material abundance. Having succeeded on a scale hitherto unequaled



nak," and "foreman of the foremen." He left a striking message for posterity: "I became great beyond words," he wrote. "I did no wrong whatsoever."

No engineer today would dare to think in such terms—least of all in Egypt. After the thrill of the antiquities comes the ironic recognition that there is almost as much in this ancient land to abash engineers as there is to inspire them. Certainly the High Dam at Aswan is a classic case of technology gone awry. Built with the worthy goal of providing power and controlling river floods, it is silting up with alarming speed, has inundated precious lands in Nubia, and wreaks havoc with the

in history, they were inspired to go beyond physical need and gratification to create mighty temples and works of art. This manifestation of the human spirit still endures. We create engineering works not only to survive and prosper but also to express transcendent aspirations. This gives us hope that today's Egyptians—with the help of the world's engineers—will conserve the antiquities that testify so movingly to human potential. ■

SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, Blaming Technology, and The Civilized Engineer.

Taking the High Road to Growth

FROM City Pride Bakery in Pittsburgh—the largest commercial bakery in Western Pennsylvania, employing several hundred people and using state-of-the-art ovens—to the plywood manufacturing cooperatives of the Great Northwest and the metalworking shops of northern Ontario, worker-owned and worker-managed companies are springing up throughout the continent.

When the owners of Weirton Steel in West Virginia decided to give up on making steel and shut down, the employees bought the mill and now run it themselves. The United Steelworkers of America (which happens not to represent the Weirton workers) once opposed such arrangements on the grounds that they embodied nothing more than “self-exploitation.” Now the union is lending legal and financial assistance to worker buyouts as a way of saving jobs and achieving technological modernization.

Because they are less interested in capital gains or cashing out, worker-owners tend to take a longer-term view of the business. The best of these companies, in industries from steel to airlines, forgo wage increases (and cap the salaries and perks of hired management) to invest in the training and equipment that will bring tomorrow’s growth. In short, they take the “high road” to economic growth.

Along this path, companies invest continuously in their employees’ skills and in new equipment and technologies for manufacturing, offices, warehouses, and transportation. The bigger firms help upgrade the technical capabilities of their smaller suppliers. Through this combination of technology, training, and technical assistance—the three T’s—the productivity of the national economy increases, and, with it, the prospects for a rising standard of living.

Unfortunately, too many U.S. companies are stuck on the less admirable “low road.” Managers try to beat out the competition by cheapening labor costs. They move whatever operations they can to low-wage Third World countries. They scrimp on training. They “out-

source” work that used to be performed in-house to subcontractors who can’t or won’t provide decent wages, adequate health insurance, or paid sick leave.

Low-road companies try to squeeze the last ounce out of older capital equipment rather than steadily retool and upgrade their technical capabilities. They play their suppliers one against another to get the cheapest price today, giving little thought to the negative impact this can have on the quality of tomorrow’s deliveries. At the last extreme a company “hollows” itself out, abandoning manufacturing altogether to become an importer of goods made by foreign companies—or by its own overseas subsidiaries.

Throughout this century, U.S. business has been at war with itself over whether to travel the high or low road. During the Reagan-Bush era, the decision to travel the low road won out more often than

long-term investments in the three T’s.

From President Clinton on down, it has become fashionable to point to recent trade successes—such as growing exports of aircraft, cellular phones, and pharmaceuticals—as a sign that U.S. companies are back on the high road. But it’s not so. Unusually favorable exchange rates (promoted by U.S. government officials “talking the dollar down”) have lulled us into a false sense of security. As Motorola CEO George Fisher tells all who will listen, the basic technological and organizational conditions—those that make an economic system poorly or well positioned for modernization and competitiveness—have not changed.

The economic stimulus package originally proposed by President Clinton called for bold new federal investments in the three T’s. Unfortunately, that ambitious plan had to be severely com-



not. How do we know? The Federal Reserve tells us that annual growth in industrial capacity declined steadily between 1981 and 1993. And the Census Bureau reports that average real wages stagnated while earnings inequality continued its long, slow drift upward.

During the presidential campaign, pundits constantly pressed Bill Clinton to specify exactly what sacrifices he would ask of the American people. Here is one that ought to be high on his list: a challenge to American business leaders to sacrifice short-term gain—to put aside the temptations of the low road—and instead to collaborate with their employees and their suppliers to make

promised to get Congress to go along with the deficit reduction and health reform programs. Such are the realities of political life.

But when public investment strikes out, the underlying problems that led to advocating it do not magically disappear. All that has happened is a shift of responsibility: the burden of promoting productivity growth now falls even more squarely on private business. ■

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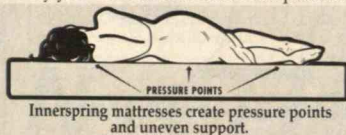
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What Science Can and Cannot Do

A SCIENCE establishment that has launched the electronic revolution, filled the skies with U.S.-developed aircraft, eradicated polio and smallpox, and built a university system that attracts graduate students from around the world may not seem like it needs fixing. Nevertheless, a new philosophy of science funding is emerging in Washington. According to this view, basic research has failed to deliver benefits to match its costs. Therefore, federal R&D money ought to be increasingly directed toward applied research projects that offer more tangible payoffs.

For example, a commission of the National Science Board recently concluded that basic research funded by the National Science Foundation, which the board oversees, was not directly stimulating U.S. economic growth. Lewis Branscomb, a member of the NSB commission and a professor of public policy at Harvard University, wrote that "NSF must recognize that the U.S. technical community is weaker than it should be in many fields that are quite exciting intellectually but [that] also could make a very big contribution to the nation's technological competitive advantage." Likewise, the rhetoric from the White House and Congress emphasizes jobs and industrial strength. Rep. George E. Brown, Jr. (D.-Calif.), chair of the House Science Committee, wrote last year that "it borders on the ridiculous" for basic researchers to claim "an entitlement to a large and increasing portion of the national income but no obligation to be concerned about threats to our well being."

This growing emphasis on social and economic benefits threatens to drive a wedge through the research community. Applied researchers, who see their work



as more compatible with the present demands for economic relevance, may be tempted to join the critics of pure science.

It would be unwise, however, for the applied science community to accept the premise that funding ought to chase near-term gain. The belief that economic growth will follow quickly from government investment in specific, applied projects has not been upheld. The nuclear breeder reactor, synthetic fuels, and high-temperature superconductors are all cases where federal sponsorship of applied research has failed to produce an economical technology.

The trail from research to product is fuzzy at best. Just as pure research cannot be seen as the culprit behind the lack of U.S. competitiveness, applied research should not be counted on to

turn U.S. industry around within a congressional term.

The space station stands as an example of what can happen to a program that derives its support from supposed economic benefits. The United States has spent more than \$8 billion on the station, motivated in large part by advocates' exaggerated claims that building the orbiting structure will keep U.S. aerospace companies ahead of their international competitors, and that space-based experiments will lead to new industries. The space station barely survived the Congressional budget ax, and emerged in a smaller, less expensive, and more politically palatable form.

Despite the general clamor for more practical work, arguments for basic research can still be heard in Washington. The National Science Board commission that called for more applied research also placed primary blame for

*The growing
emphasis on
economic benefits
from scientific
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timetables and
false expectations.*

failing to bring competitive technology to market not on the research enterprise but on other factors, including inattentive U.S. business leaders. Indeed, the board concluded that redirecting NSF's activities too much from research and education would not help raise U.S. economic strength in the near term and would hurt us in the long term.

A similar note of support came in a report released last December from the President's Council of Advisors on Science and Technology (PCAST). Fundamental research is not an "intellectual luxury," PCAST declared, but rather "a national imperative." Nevertheless, the council's report called on research universities to face up to the new funding realities—specifically, to do more collaborative work with industry and to "eliminate or downsize some departments and specialties."

Despite its earlier rhetoric about long-term investment in basic science, the administration's technology policy, it has now become clear, boils down to the creation of jobs in the short term. Unfortunately, the technical community has been reluctant to acknowledge that many science and technology efforts, even those that can be labeled "applied," will create very few jobs anytime soon.

Applied researchers thus face a dilemma. They can support the new emphasis and grab the higher funding it promises while hoping to produce results within a few years. Or they can be cautious, describe the likely time scale for results, and risk the possibility that Congress and the administration will turn their attention (and largesse) to those opting for the first approach. A third approach is even more difficult, but potentially the most beneficial: frankness about the difficulty of achieving results, prudence on claims about the time needed to produce new jobs, and targeted emphasis on which areas are most likely to be productive. ■

JOHN AHEARNE is executive director of Sigma Xi, the Scientific Research Society.

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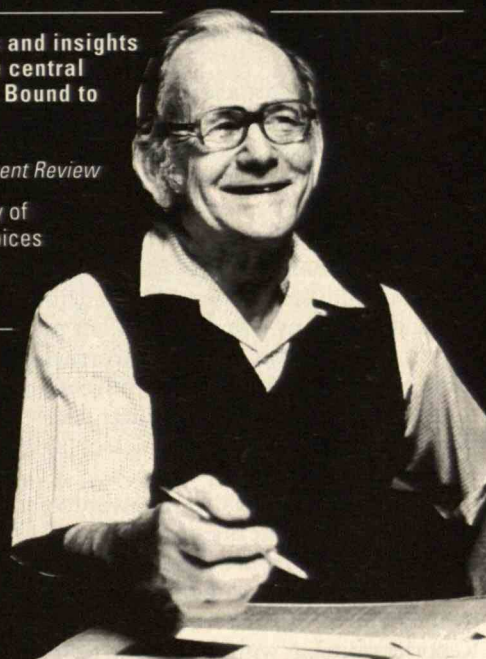
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Panic Gluttons

NOT long ago, the telecommunications industry was jolted by a bolt-out-of-the-blue allegation that the use of cellular telephones could cause cancer. The charge stemmed from a Florida man's search for an explanation of his wife's death from brain cancer. His case was purely circumstantial: his wife, a cellular phone user, died of a tumor near where the base of the antenna is held.

Although the man's lawsuit against a cellular telephone manufacturer and a service provider lacked scientific or medical corroboration, a single airing on *Larry King Live* had the story off and running. The husband, a self-described "electronics junkie," hit the interview circuit, telling one questioner, "We are going to find out that we are killing off white-collar workers left and right." With 11 million cellular users across the country and thousands more signing up every day, the story proved ripe for exploitation. One TV interviewer asked whether cellular users were "dialing for death."

The flames of suspicion were fanned by sensationalistic conjecture that the brain cancers of two prominent corporate CEOs might be related to cellular use. Although the telephone habits of neither were known at the time, fact seemed little match for speculation and emotion. Industry experts wanted to respond, but many refused invitations to appear on television, rightfully worried that their explanations would prove no match for guests blaming cellular telephones for the deaths or illnesses of loved ones.

When the industry did step forward to confront the scientific questions, it found that talking about them with a science writer was not the same as debating them before (or with) a studio audience. Reporters familiar with science and technology issues—especially those in the employ of major newspapers and mag-



*The cellular
telephone scare shows
what can happen when
purveyors of junk science
feed public fear.*

azines—did an admirable overall job of placing the controversy in context. They pointed out that although radio waves at certain power and frequency ranges can have biological effects, there are caveats: those effects cannot be assumed to adversely affect people's health, and they have never been seen at the power and frequency levels of cellular telephones. Unfortunately, for many citizens the

subtleties were lost as the drama played out in the ratings-dependent arena of talk TV and under the purview of crusading consumer reporters, who were quick to dial "p" for "panic," as *Time* magazine observed.

The cloud over the telecommunications industry dissipated with time, but the scare remains illustrative of what can happen when the public gets its science from non-science journalists. The popular media's obsession with controversy and their rush to expose unseen "dangers" to public health can threaten what good science journalism seeks to accomplish: better public understanding of complicated issues.

In this case, the controversy arose not over evidence that cellular phones cause cancer but whether scientists could conclude with absolute confidence that they do not. Such a demand subjugates science to an oversimplified view that what we can't prove, we don't know, and what we don't know, we should fear.

Sociologists may diagnose this reaction as part of a larger social malady. Authors Barbara Ehrenreich and Todd Gitlin recently wrote in *The Washington Post* about Americans as "panic gluttons": each day brings another media-induced crisis about hazards to mind or body. One threat after another arises out of nowhere, carried to extremes by vicious cycles of media coverage that feed on—and fuel—public anxiety. "Instead of approaching public problems systematically, consistently, we seem to lurch, fearfully, from spasm to spasm, like a paranoid in search of fresh enemies," according to Ehrenreich and Gitlin.

Some of this mess may reflect the state of the human condition in a highly advanced, complex society. But the cellular safety scare made it clear that the popularity of tabloid television shows has made Americans more susceptible than ever to junk or incomplete science.

Something is very wrong, and the public interest poorly served, when unsubstantiated allegations in a lawsuit are accorded the status of scientific finding. Today it takes no more than one or two voices questioning the status quo to raise the specter of another demon in everyday life.

Although the cellular scare is over, at least for now, others are certain to follow. We cannot realistically expect the *National Inquirer*—and its TV equivalents—to adhere to the same standards as the *New York Times*. But hope is not lost if scientists themselves learn to communicate their findings more effectively, both to one another and to the larger community.

Scientists need to recognize that in today's information age, scientific debate is no longer confined to the science pages and academic gatherings. They must be better prepared to argue and explain science in venues where critical distinctions, in the absence of expert participation, all too often can be lost.

When this issue surfaced at a recent science/industry conference, one noted researcher suggested that the nation's schools bear responsibility for improving public understanding of scientific issues. In her view, widespread scientific illiteracy is to blame for an uninformed or misinformed public.

As a practical matter, we cannot afford to wait for education reforms to raise the general level of scientific sophistication in this country. For the foreseeable future, we will continue to look to scientists to sort out fact from fiction and assess relative degrees of hazard and risk. From members of the scientific community, that demands patience and even tolerance. From all who have a hand in shaping public opinion, it demands diligence, both in understanding science themselves and in explaining it to others. ■

NORMAN D. SANDLER, a former White House correspondent for United Press International, is a senior associate at Powell Tate, a public relations firm based in Washington, D.C. The firm's clients include members of the cellular telephone industry.



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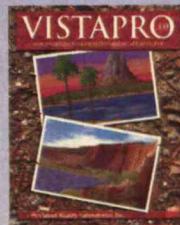
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Reviews

BOOKS

BEYOND QUARTERLY EARNINGS

*Winning in High-Tech Markets:
The Role of General Management*
by Joseph G. Morone
Harvard Business School Press, \$29.95

BY STEPHEN D. SOLOMON

THE fall of Corning Inc. from the top reaches of U.S. industry seemed to happen in a moment. Only a few years before, *Forbes* magazine had called it "one of the strongest companies in American industrial history." But as its products grew old, and more nimble foreign competitors stole away its business, it shuttered five factories and laid off nearly a quarter of its workforce.

This familiar tale could describe the fortunes of a universe of companies, including IBM, General Motors, and Digital Equipment, and all within the last year. But the fall of Corning occurred in 1975. Corning's story is significant not as an early warning of what would befall many of the nation's leading companies. Rather, it is an example of how a company that once flashed like a bright comet across the sky and then disappeared from view can come around for a second pass.

In the mid-1960s, Corning was a diversified glass-ceramics company, manufacturing everything from medical optics to kitchenware. Its biggest product, however, was black-and-white television bulbs (the glass envelopes that house picture tubes), the market for which Corning completely dominated. That business evaporated as television manufacturing went overseas and competitors hammered away at the remaining customer base. In 1975, Corning pulled out of the television-bulb market altogether.

Even as it seemed to pass out of sight,



Corning had in place all the elements that would propel it in the future. In its laboratories were the beginnings of promising new products. More important, it had managers who wanted something more than a formulaic return on investment.

The results have been stunning. Corning now dominates an optical fiber market that was targeted years ago by the Japanese Ministry of International Trade and Industry. And it is one of the few manufacturers capable of producing the high-performance glass required by Japanese makers of those ubiquitous liquid-crystal displays.

Is Corning a model for the many U.S. technology companies that have been battered by foreign competitors in recent years? You bet, says Joseph G. Morone, dean of management at Rensselaer Polytechnic Institute. In *Winning in High-Tech Markets: The Role of General Management*, Morone examines Corning and two other companies that dominate high-tech industries: General Electric in diagnostic medical systems and Motorola in mobile communications.

All three companies have achieved global leadership in the kinds of technology markets in which Japanese competitors have lately gained the upper hand—

markets characterized by fast growth, short product cycles, and the necessity for heavy investment in new products that will not come to fruition for many years, if ever. As technology leaders, they stand in stark contrast to the innumerable U.S. companies that were pushed aside by the Japanese in markets such as semiconductors, electronic displays, and consumer electronics.

What Went Right?

Morone's book is a refreshing departure from the mainstream analysis of America's economic troubles. Most commentators have focused on what went wrong—on corporate disasters, on greed and theft on Wall Street, on national priorities gone askew. Another group of commentators have examined the climate in which companies operate, arguing that business cannot compete effectively while burdened by closed foreign markets, an unhelpful tax policy, and a high cost of capital.

But Morone looks at the problem through a different prism. After all, Corning, Motorola, and GE Medical Systems prospered in this difficult business climate. Morone's research was driven by a simple question: Why? The answer, he contends, lies mainly in factors that are firmly within management's control.

Foremost is the management team itself. At the three companies he examines, virtually all the top leadership positions were filled by engineers. But technical fluency alone was not enough. Unlike many large corporations with high job turnover, the three companies were led by people who had become immersed in the company's technology through decades of service. Managers who initiated ambitious research and development projects stayed around to guide them to fruition, while at other companies frequent changes in top personnel brought frequent changes in priorities.

An even more critical trait of these top managers was an utter joy in competing. Despite their size, the three compa-

nies maneuvered more like the sleek catamarans of Silicon Valley than the portly battleships of the *Fortune* 500. Managers identified their company's technological strengths, then made an all-out commitment to achieve global domination within those areas.

When Corning began its big push to develop optical fibers for telecommunications in the mid-'60s, for example, the total market amounted to only about \$15 million, and the company faced the daunting task of improving the light-carrying capacity of glass by orders of magnitude. Many of Corning's potential customers, notably AT&T, were developing optical fibers themselves and hence were also potential competitors. Corning pushed on, convinced that a big market would develop. One did, and the company eventually won a large MCI contract that made it a major player in that market.

While the specific challenges were different for the three companies, Morone identifies many similarities in the way they approached their markets. Most important was the belief that leadership meant making products that were "best in class." Rather than allow foreign competitors to gain a foothold in the low end of the market and then move up to higher price categories, as happened in the auto industry, these companies vigorously pursued leadership in every price tier. And instead of trying to lead through either low cost or high quality, they did both.

Motorola, for example, embarked on a major campaign in 1981 to reduce product defects. The goal was continuous, incremental improvements that would make each product line the best in the world, a strategy the Japanese have used to capture a number of technology markets. Motorola set a goal for all its product lines of 10-fold improvement in five years and reached that goal throughout much of the company in just three. Then it pushed for yet another 10-fold improvement. As part of that effort, the company spent \$50 million in 1988 and \$60 million in 1989 to train and educate employees about quality. Every

department within the company examined its operations to determine the cause of defects and then redesigned its procedures accordingly. As a result, the U.S. Department of Commerce picked Motorola for a Malcolm Baldrige National Quality Award in 1988. Along the way, the quality campaign improved efficiency and drastically lowered costs, saving Motorola \$250 million a year between 1987 and 1989 and \$500 million in 1990.

Yet incremental improvement of existing products was only half the story for Corning, Motorola, and GE Medical Systems. All three doggedly pursued radically new technologies. Corning invested 17 years and \$100 million in R&D before its optical fiber business reached profitability. Motorola invested 15 years and \$150 million in cellular phones before realizing its first sales. And GE spent 7 years and \$300 million developing magnetic resonance imaging before the technology became profitable.

These successes were possible only because the companies eschewed the financially driven style of management that has dominated American business over the last decade. Instead of basing decisions on rate-of-return calculations, which are guesses at best, these firms asked whether a project fitted into their strategic focus and what steps they had to take to stay well ahead of the competition. In fact, reliance on financial models would probably have killed GE's advanced diagnostic imaging equipment before it got off the ground; the future size of the market and the progress of GE's technology development were highly uncertain.

Cultivating Enterprise

By the end of the book, it's clear that entrepreneurial leadership is critical to the long-term success of a technology company. But how do we develop more such leaders? Unfortunately, Morone is not as helpful here as he could be.

For the most part, Morone's prescriptions concern the climate in which busi-

ness operates and the way in which government funds technology research. The various reforms he proposes—among them a steep cut in the capital gains tax, the granting of R&D and investment tax credits, and a redirection of government support for R&D—could improve the climate for long-term investment and encourage managers to act more aggressively. Some of his prescriptions are already being debated in Washington. But such proposals skirt the main question that drove Morone's research: How are these three companies different? After all, Corning's management did not wait for changes in tax policy or a lower cost of capital before it invested in optical fiber.

Commentators have long bemoaned the ascendancy of financial managers to positions of corporate leadership. Many of these managers do not fully understand their company's products or how they are made. For many of them, running a company is a financial exercise that buries ambitious projects under megabytes of numbers. At Corning, Motorola, and GE Medical Systems, top managers understood the technology and looked at business as an exercise in innovation.

How to cultivate that attitude in the ranks of top management remains a fundamental challenge. As Morone briefly notes, managerial training at major universities must change to emphasize technical innovation. And corporate directors and investors, heeding the lessons of Corning, Motorola, and GE Medical Systems, must find ways to encourage and reward managerial decisions that look beyond the next quarterly earnings—investments that build strength over the long run. By analyzing three companies that succeeded in doing so, Morone has provided technology-based business with something it sorely needs: inspiring role models. ■

STEPHEN D. SOLOMON, an associate professor of journalism and mass communication at New York University and a business writer, has served on the staffs of both *Inc.* and *Fortune*.

BOOKS

ALL ROADS LEAD TO PROSPERITY

Ways of the World: A History of the World's Roads and of the Vehicles That Used Them

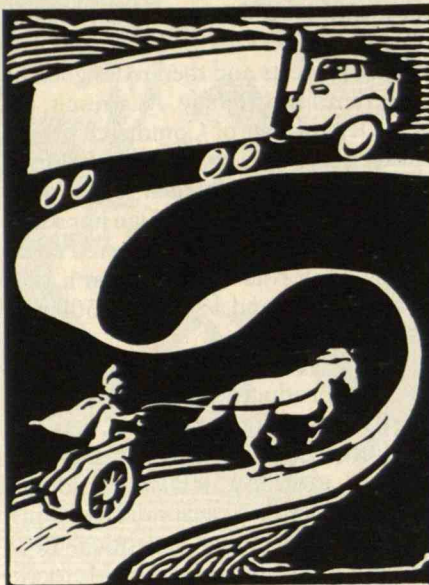
by M.G. Lay
Rutgers University Press, \$50

BY DAMIAN J. KULASH

SEVERAL years ago, Bates College economist David Aschauer stirred up a national debate by arguing that investments in infrastructure were a major determinant of economic growth. He contended that the "golden age" of the U.S. economy, the prosperous 1950s and 1960s, may have been a direct result of the large public works investments of that period. Others have argued that Aschauer overstated his case.

Econometric analyses alone are unlikely to resolve the issue, since hard data have not been collected long enough. Yet history speaks louder than numbers. The link between at least one form of infrastructure spending—highway investment—and economic growth becomes abundantly clear when viewed across the entire span of civilization.

Perhaps for the first time, one can now appreciate that history in a single volume. *Ways of the World*, by M.G. Lay, an Australian highway official, traces the development of roads from animal track to superhighway, from Afghanistan to Zimbabwe, and from ox cart to 18-wheeler. Lay has embellished his narrative with hundreds of historic firsts—like the earliest known female highway engineer, who worked on roads in ancient China, and the oldest existing centerline marking, laid down around 1600 on a road between Mexico City and Cuernavaca. But the book is most remarkable for its sweeping breadth. Though more an engineering



history than an economic one, *Ways of the World* covers enough territory to show that Aschauer's conclusions about the economic importance of infrastructure are, if not unassailable, then certainly on the right track.

Building Empires

Road building and prosperity have almost always risen and fallen together. The extraordinary scope of the Roman road system, for example, not only aided central control and military dispatch but also opened up an international economy that ushered in unprecedented global wealth. As the Roman Empire disintegrated, so did its attention to roads. Many of them fell into decay in the Dark Ages as international trade slowed, and some of the stones were pulled up and used to build castles and churches. Road-building know-how languished.

Hundreds of years later, near the end of the eighteenth century, the rebirth of paved roads was a key catalyst for the Industrial Revolution. In modern times, the huge number of U.S. shopping centers, industrial parks, and housing developments that have sprung up near interstate highways attests to a strong relationship between economic development and transportation infrastructure.

As Lay points out, gains in the speed or efficiency of transportation spur economic growth by expanding the market for both raw materials and finished goods. This is equally true whether the improvements are in roads or in the vehicles that travel them. But while both roads and loads serve the same economic purpose, the marriage between them has been a stormy one. The Roman emperor Theodosius II tried unsuccessfully in 438 A.D. to bring the requirements of vehicles and highways into equilibrium by setting weight limits on horses and carts, and the issue has not settled down since.

Modern leaders face a continuing struggle to develop regulations on truck size and weight that best balance competing productivity, engineering, safety, and financial concerns. For example, larger trucks can move freight at a lower cost per ton-mile, but they wear out pavements faster. Upgrading all roads, of which there are almost 4 million miles in the United States, would be prohibitively expensive. So decisions to raise weight limits and improve pavement must be targeted to carefully selected stretches of highway.

Each time a weight change is proposed, truck manufacturers and highway officials come forward with new and contradictory data on productivity gains or pavement damage. Like the wheel, this argument just keeps rolling along as technology advances. The important thing is that the technology does advance—to the point where highway transportation is now the backbone of our modern distribution system and a key to economic vitality.

Lay discusses in great detail the advances in engineering and materials that led to the dominance of highway transportation. Asphalt, for example, which forms naturally in oil-bearing rock, has been used since antiquity in the Middle East. Nebuchadnezzar, the Babylonian king, boasted of his fine brick roads mortared with asphalt. Abandoned by the Persians, Greeks, and Romans, asphalt was rediscovered by a Swiss physician, Eirini d'Eyrinys, early in

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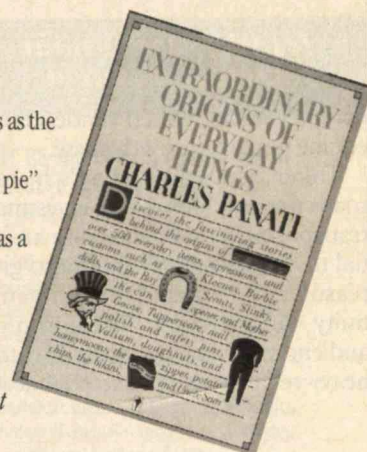
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the eighteenth century. While the good doctor may have oversold the material's medical applications—he proclaimed it a universal panacea—his discovery opened the door for other uses of asphalt, particularly for paving.

Asphalt was commonly used to build footpaths around 1800, but was too slippery and too easily rutted to be used on streets. Eventually engineers learned to add sand or crushed stone, rendering asphalt tough enough to stand up to horse hooves and ironclad cart wheels. By around 1890, strong mixes of natural asphalt and stone were routinely used for streets. Because it is much smoother than cobblestones and other paving materials, asphalt allowed more goods and people to be transported with less horsepower. It now covers 95 percent of the paved roads in the United States.

Paved with Good Intentions

Alas, the economic benefits of highway development are but one side of the story. Anyone living in twentieth-century America knows the other side all too well: road transportation exacts enormous costs in fuel consumption, environmental damage, lives lost, and space required. As population grows and development increases, these burdens are becoming untenable. But lest anyone despair that the magnitude of today's woes is unprecedented, *Ways of the World* puts them into perspective.

On a typical day in 1900, horses endowed the New York City streets with 1,200 tons of manure, 70,000 gallons of urine, and 20 fresh carcasses. Rain made the dirty streets disgusting to cross and turned them into a conduit for tetanus and other diseases. The steel-rimmed wagon wheels were noisy and blamed for causing nervous disorders. They also ground even the best pavements to dust. There was one horse for every four people in the United States, and they required 88 million acres—a quarter of the nation's crop area—just to feed them. The cost of this transportation system, in food and filth, was staggering and could not be sustained

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as the nation grew. But Malthusian forecasts of technological limits prompted the adoption of a new technology, the motor vehicle, which rendered all the equine limits to growth passé.

Taken as a whole, Lay's history of roads not only shows that investments in transportation infrastructure are essential to economic growth. It also gives us reason to be hopeful that human ingenuity will overcome the environmental and energy problems created by today's heavy reliance on the automobile. ■

DAMIAN J. KULASH is executive director of the National Research Council's Strategic Highway Research Program, a congressionally mandated effort to improve road materials.

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THE PERILS OF EXPERTOCRACY

In "Regulations Shouldn't Be Relics" (*TR May/June 1993*), Robert White conveys a disturbing and thinly veiled message: scientists are more capable of creating rational public policy than



the public at large. The notion that we should turn environmental regulation over to a self-appointed scientific expertocracy is dangerously antidemocratic.

Moreover, White offers no real support for his main thesis that many environmental rules have been invalidated by scientific progress. For instance, the Delaney clause, which he criticizes as hopelessly out of step with modern analytical techniques, merely states that chemicals that cause cancer in humans or animals cannot be used as food additives. There is nothing irrelevant or illogical about this policy, nor has it somehow been outmoded by our current ability to quantify parts-per-trillion concentrations. Far from invalidating the Delaney clause, new technologies increase our ability to enforce it. And while White may feel strongly that the Delaney clause is not good public policy, his opinion has little to do with science. It is no more or less valid than the opinion of a movie star, housewife, truck driver, or member of Congress. Delaney may well need to be revised, but this is certainly not a decision that should be left exclusively in the hands of scientists.

White also cites the failure of our national ozone pollution policy to keep up with science, concluding that regulation has been "seriously misdirected" for the past two decades. Yet the National Research Council report on which he bases this assertion was mandated by the Clean Air Act amendments of 1990 precisely because of the recognized need to update our strategy. As is often the case, policy has been advancing scientific understanding rather than lagging behind it.

Americans have a long history of resisting decision making by so-called experts. If a murderer pleads insanity as a defense, psychiatric experts may be called upon to inform the debate, but it is a lay jury that makes the ultimate decision. Doctors may be eminently well versed on the biological processes of pregnancy, but it is the individual woman who chooses whether to bring her pregnancy to term. When Congress becomes more responsive to expert, professional lobbyists than to the general public, it corrupts rather than enhances the democratic process. I'm not entirely sure what White means when he says that "all environmental legislation should build in a mechanism for updating regulations based on the periodic review of the underlying science and engineering," but it strikes me as a terrible idea just the same. No group of scientific experts should be given authority to privately undo regulations that have been publicly created.

DAVID SAROKIN

Environmental Protection Agency
Washington, D.C.

DESIGN IN THE REAL WORLD

Donald Norman's "Toward Human-Centered Design" (*TR July 1993*) offers astute insights. Yet in some ways his analysis obscures and trivializes the issues.

First of all, design decisions in the real world are most often made by teams of engineers following corporate managerial directives. Corporate decision makers are influenced in turn by diverse market pressures, by the legacy of government R&D policies, and by design imperatives encoded in the pre-existing technological order. There is little point in demanding change without exploring the social forces that perpetuate our current situation or seeking a political-economic strategy that could encourage improvement. To promote authentically human-centered manufacturing methods, doesn't it seem vital to attend at least as carefully to government policies, institutional power relations, and social interests as to the psychological foibles of engineers?

Classifieds

Second, Norman's examples of human-technology interaction all involve one user and one machine. But in the real world, many of the most important interactions involve aggregates of people whose interactions are patterned by an entire technological order in which no one machine predominates. For instance, many Americans mourn the decline in face-to-face community relations. In part, that decline has been technologically induced. Single-family detached homes and high-rise apartment buildings, the noise and danger of automobiles, the roar of power lawnmowers, and the allure of air conditioning and television have all conspired to erode the tradition of neighborly gathering on sidewalks, stoops, and porches.

Norman's version of human-centered design would doubtless ensure easy-start lawn mowers, driver-friendly dashboards, and saner ways to choose what to watch on television. But he doesn't begin to grasp technology's most profound social and political effects. A genuinely human-centered approach to design would strive to engage people from all walks of life in building a more democratic, convivial, peaceful, and environmentally sustainable technological order. Smart phones, electronic TV guides, and safer cockpits are fine as far as they go—but that isn't terribly far.

RICHARD E. SCLOVE
Executive Director
The Loka Institute
Amherst, Mass

CORRECTION:

The caption to the photo of Karen Strier on page 14 of the August/September issue was incorrect. It should have read:

Karen Strier, an anthropologist working in the Brazilian Atlantic forest, thinks animals may be our best guides to the potential use of the forest as a pharmacy in regions where local healers are no longer present.

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Phenomena

By DAVID BRITTAN

FISH STORIES ♣ Susan McLaughlin cannot emphasize strongly enough the importance of routine eye examinations for catfish. It's not that there's all that much to see in a catfish pond. Rather, McLaughlin theorizes, the eyes of fish, like those of humans, might reveal subtle symptoms of disease elsewhere in the body. At stake could be the very health of the catfish industry. In Alabama, where McLaughlin is a veterinary ophthalmologist at Auburn University, catfish farmers lose millions of dollars a year to viral and parasitic infections that either stunt the fish's growth or send them belly up. The solution she is investigating is to anesthetize a sample of fish from a pond and use a magnifying lens to inspect their retinas for early signs of infection, just as physicians do with human patients. Farmers would then have time to treat the tasty bottom dwellers with antibiotics.

Even as science is serving catfish in Alabama, a variety of carp is serving science in the German state of Baden-Württemberg. A government-run monitoring station for testing the water quality of rivers uses not only electronic chemical-analysis hardware but some fancy "wetware" as well: the golden orfe. Like a canary in a coal mine, the orfe is a sensitive pollution detector. The fouler the water, the faster the fish tires and drifts against a sensing grid in its tank, setting off an alarm. According to Siemens AG, which built the station, electronic devices can test for a few key contaminants, but nobody knows general water quality like the golden orfe.

Ironically, the orfe might find life easier in the middle of Israel's Negev desert. There a

food fish known as tilapia basks in warm artificial ponds fed by an aquifer a mile beneath the surface. The combination of bright sunlight and mineral-rich water is ideal for raising fish, according to the project's aptly named originator, Lev Fishelson, an aquaculturist at Tel Aviv University. Algae develop so fast in this environment that they can provide most of the food the tilapia need to grow. And grow they do.

Using the same allotment of underground water as neighboring farms use for irrigation, the ponds yield some 40 tons of fish per acre per year—"about as good as anybody does with any kind of fish," according to John Todd, president of Ocean Arks International, an ecology research institute in Falmouth, Mass. Fishelson believes desert fish farms could relieve hunger in other regions such as the Sahara, which also lies on top of sizable aquifers. The downside, if you are a tilapia, is that you must take a vow of chastity: to control population, all the fish are male, the result of breeding male Jordan tilapia with female Nile tilapia.

FOR MEN ONLY ♣ Until *Homo sapiens* is willing to take a similar vow, the search for a male birth-control pill will continue. With that aim in mind, a biochemist at North Carolina State University wants to create a "blind" sperm. Most research on contraception for men focuses on the testis, where sperm are produced, but Joseph Clemon Hall is studying the epididymis, the convoluted tube where the little fellows learn to "see."

When they first begin their wild ride, sperm are incapable of recognizing and binding to an

ovum. It is on the 15- to 20-foot journey through the epididymus that the necessary glycoproteins (molecules consisting of proteins and sugars) attach themselves to the surface of the sperm. Only the cells lining the epididymus secrete such molecules. So Hall reasons that it ought to be possible to disrupt this process—and thereby knock out the sperm's "eyes"—without affecting other parts of the body. His grail is a drug that interferes with the production of sugars in the epididymus. In the meantime, he is busy determining exactly which of many glycoproteins govern sperm vision, and raising seven children.

HORNS OF A DILEMMA ♣ A

gentleman rhinoceros is in no position to reproduce at all if a lady rhinoceros doesn't like the look of his horn. Imagine his embarrassment, then, if this noble protuberance is missing. To protect African black rhinos from poachers who kill them for their horns—a prized ingredient in Far Eastern medicines—Namibian game officials surgically remove the source of temptation. This practice does more than cramp the animals' style: it makes it harder for them to forage and defend themselves. If Robert Malloy and John Linehan have their wish, the well-dressed rhino may soon be sporting a bright-orange plastic prosthesis in place of its natural horn. Malloy, a professor of plastics engineering at the University of Massachusetts at Lowell, has made replacement horns for other animals at Boston's Franklin Park Zoo. He and Linehan, the zoo's curator, believe a prosthesis would deter poachers with little inconvenience to the color-blind rhino. Their first step will be to test

Malloy's new prototype in a zoo. With only 3,000 black rhinos left, they had better hurry.

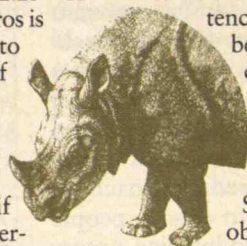
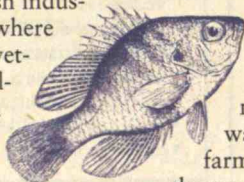
MORE HEAT THAN LIGHT? ♣

As the rhinoceros faces extinction, contradictory findings about dark matter are thriving like tilapia in the Negev desert. Dark matter is the hypothetical invisible gravity source that astronomers invoke to explain how galaxies can spin as fast as they do without falling apart. Douglas Lin, an astronomer at the University of California at Santa Cruz, reports that the orbit of a galaxy called the Large Magellanic Cloud around the Milky Way shows that our galaxy contains five to ten times as much matter as is visible. "It proves the existence of dark matter beyond a doubt," he concludes. But not in all galaxies, apparently. Two other astronomers, Robin Ciardullo of Penn State and George Jacoby of Kitt Peak National Observatory, have

measured the speeds of gaseous objects known as planetary nebulae in the M105 galaxy, 33 million light years away. Their conclusion: no dark matter there. The overall behavior of M105 "is exactly what you would expect from a galaxy made of ordinary stars," reports Ciardullo.

MESSAGE FROM DEEP SPACE ♣

Closer to home, *Pioneer 10* still keeps in touch a decade after leaving the known solar system. Its latest finding is that the sun's atmosphere, the so-called solar wind, extends 10 times farther than scientists had thought—perhaps more than 9 billion miles. According to NASA, it will be at least another five years before the little space probe signs off for good.



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